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POSSIBLE ELECTRICAL DEVELOPMENTS IN PERU.

An interesting contribution from Mr. E. Guarini, of Lima, Peru, concerning the possible electrical development of Peru will be found on another page of this issue. Mr. Guarini has inspected the hydraulic powers of the southern part of that country with a view to their development. Although, as he explains, there are large potential sources of power in the rivers flowing into the Pacific, these can hardly be used, since the water is required for irrigation. He therefore proposes the rather startling plan of drawing a certain amount of water from Lake Titicaca, and precipitating it down the west slope of the Cordillera, utilizing it in its fall for power purposes, the waste water finally being turned over to be used for irrigation.

The projected plans are very ambitious and if carried out will be a great achievement, for some millions of horse-power may thus be obtained, and the effect of this cheap power on Peru can not fail to be important. Cheap transportation, cheap manufacturing—in fact, all processes requiring cheap power—will at once become available. Agriculture, which it seems at the present time is greatly hampered for lack of cheap power, either for transportation or for tillage, will take on a new life. The mines also suffer from the same trouble. The railways will be able to save nearly all of their coal bill, and transportation throughout the country will be easy. In fact, the effect of cheap power will be felt in every branch of business, and there is some reason for agreeing with Mr. Guarini in the prophecy that, upon the successful carrying out of the project, Peru will take a great leap forward and become an important industrial country. This will be another noteworthy triumph for the electrical transmission of power.

THE NEW YORK, NEW HAVEN & HARTFORD LOCOMOTIVE.

The paper read by Mr. B. G. Lamme at the recent meeting of the New York Railroad Club is interesting from many points of view. It describes the alternating-current electric locomotive, the newest rival of the old steam locomotive, which has been constructed by the Westinghouse Electric and Manufacturing Company for the New York, New Haven & Hartford Railroad, and gives the reasons for the selection of this type. There is no need to discuss at this time the advantages and the disadvantages of the various electrical systems which have been proposed for trunk line operation, but it may be worth while to point out certain features of the new machine.

The most striking of these features, aside from the use of single-phase motors, is the adoption of a gearless type. The motors are mounted on quills, through which the driving shaft passes with some play, and drives the wheels by means of M flexible couplings. This construction reminds one of the first Baltimore & Ohio type, which employed a gearless motor, spring-suspended on a quill, driving the wheels through rubber cushions. The mechanical features of the New Haven locomotive method of driving are very pretty, for they not only give a flexible transmission, but allow the motor a certain amount of end and side play.

Another noteworthy feature of the motor is the use of forced ventilation to reduce the temperature of the motor, or, what is the same thing, to increase its ability to do work. Reduction in the volume of an equipment of this kind is most important on account of the contracted space in which it must be installed. For this reason the air-blast type of transformer was necessarily selected; and, having a ventilating system on the locomotive, the extension of this to cooling the motors, as well as the trans-

formers, is a slight step; yet it makes a very great increase in the allowable output of the motor. The forced air is used also to cool the rheostat employed for direct-current control, where it is also valuable.

The method by which the new locomotive controls the energy supply is probably the most advanced that has yet been applied practically. An easy method of varying the applied potential to the motors does away with any rheostatic losses when operating on alternating currents. Moreover, the new type of motor, in which the armature reaction is balanced, and in which the field is relatively weak, as compared with direct-current motors, opens the way to field control of speed. This is another ideal method of regulating the speed of an electric motor. It was used some ten years ago for obtaining higher speeds on suburban tramways, but it could not be used through a wide range because the weakening of the field was likely to start sparking. We have seen this method of controlling the speed of stationary motors taken up again of late, it being made practicable by the addition of special compensating devices for preventing sparking. In the single-phase motor, however, the auxiliary winding which is necessary to give sparkless commutation when operating on alternating currents also takes care of commutation when the field is weakened, so that this efficient method of control becomes allowable.

Another important feature of the energy control of this locomotive which is worthy of emphasis is the possibility of returning power to the line when stopping the train or when descending grades. In this country we have paid little attention to this feature, although braking cars or trains is the main source of energy loss. It seems impracticable with our standard direct-current system to apply the so-called regenerative control. In England they have done a little something in this direction, using, however, shunt motors. With the alternating-current motor and voltage control obtained through the transformer it is possible to return energy to the line and, as stated by Mr. Lamme, to do this at any desired rate when running at any speed. The only undesirable feature of this is the additional loading of the motors, but with air-cooled motors this becomes less important. The saving in power thus brought about should make a considerable saving in the cost of power for the locomotive.

An important feature of the alternating-current equipment, particularly for the New Haven road, is the ability to operate it on a direct-current, low-potential system. This feature has, however, been so fully discussed that there is no need to dwell upon it further. The new locomotive has been thoroughly tested at East Pittsburg, and according to all reports has given a satisfactory account of itself. The method of control adopted makes possible, as is usual in such electric locomotives, the coupling together of two or more units and operating them from one point, thus making easy handling of trains of any practical size. The performance of this newest machine will be watched most closely, not only because of its features, but because of the discussion which has taken place concerning this particular installation.

VARIABLE PRICES OF ELECTRIC ENERGY.

Prices of electric energy vary with the quantity used by a consumer per month, the hours of each day during which the energy is used and the purpose to which it is devoted.

In all of these cases the rates to consumers are based on the cost of energy to the electric company, plus more or less profit. Large consumers get lower rates than small ones, on the general principle that it costs less per unit to deliver a large than a small amount of power. Electric energy can be generated and distributed at a profit more cheaply at some hours of the day than at others, because lighting loads reach their maxima during the early hours of each evening, and power that existing equipment could deliver in the morning might require an increase of station capacity if carried at night. Current for lighting, particularly at incandescent lamps, must be delivered with variations of only one or two per cent in pressure in order to give satisfactory service, but at motors and electric heaters voltage variations of five per cent, or even more in some cases, are of only small importance.

For all except the smallest motors current is commonly delivered to consumers' premises at about 250 or 500 volts, and sometimes at as much as 2,400 volts, and the cost of line conductors is much less than that for an equal lighting load. In those cases where large amounts of energy are distributed for electric heating, the line losses are generally higher and the cost of conductors less than for equal lighting loads.

The large differences of price due to the volume, time and purpose of energy sales are most clearly shown by the rates for service regularly made in important electric systems. In the case of one large electric system where the energy is derived almost entirely from water power, the charge for energy used in motors is three cents per kilowatt-hour if the maximum rate at which power is absorbed by the motors is ten kilowatts, and the total amount of energy consumed during one month is 1,000 kilowatt-hours. For a consumption of 11,200 kilowatt-hours per month in motors that draw a maximum of sixty kilowatts from this same system at any one time, the charge drops to 1.3 cents per kilowatt-hour. Steam-driven electric stations charge higher rates as a rule than those that develop their energy with water power, but the same wide range of rates exists with both. A large electric supply system in New England that operates with steam power, charges 9.5 cents per kilowatt-hour where not more than 100 kilowatts are consumed in motors per month, but only five cents per kilowatt-hour if the monthly consumption reaches 1,600 kilowatt-hours.

Rates for lighting, like those for electric motive power, vary greatly between different customers on the same system, according to the amount of energy consumed by each per month. One large electric supply system in the East charges consumers at the rate of eighteen cents per kilowatt-hour for all energy used for lighting during the month of December up to a number of kilowatt-hours that is sixty times as great as the number of kilowatts drawn from the line at any one time. All energy used in December above the amount just indicated is charged

at only twelve cents per kilowatt-hour. For other months of the year the number by which the maximum kilowatts used at any one time must be multiplied, to indicate the number of kilowatt-hours beyond which the rate of twelve cents applies, varies from twenty to sixty. In this same system, if the annual consumption of energy is as much as 400 times as great as the maximum demand in kilowatts at any one time by a consumer, the rate for all energy above a certain minimum is eight cents per kilowatt-hour. At a large plant in a city of the West the lighting rate is 13.5 cents per kilowatt-hour where the consumption of energy for each sixteen-candle-power lamp connected is less than two kilowatt-hours per month. If the consumption of energy per connected lamp reaches fifteen kilowatt-hours per month, the rate drops to 7.5 cents per kilowatt-hour. In a city where the population is about 70,000 the rate for incandescent lighting is eighteen cents per kilowatt-hour up to forty kilowatt-hours per month for each kilowatt of the maximum demand made by the customer, but for energy beyond this amount per month the rate is only eight cents per kilowatt-hour.

Differences between the rates for lighting and motor service are large, and depend on the maximum demand more frequently in the former than in the latter. Thus at a certain city where the population is more than 100,000, the minimum lighting rate is 7.5 cents and the corresponding motor rate is five cents per kilowatt-hour. In order to get the minimum lighting rate the consumer must use 300 kilowatt-hours per month for each kilowatt of his maximum demand, but the consumer of energy for power purposes gets the five-cent rate if he uses 900 kilowatt-hours per month, without regard to the maximum demand. Consumers in a city where all of the electric supply is developed by a great water power are required to pay 7.47 cents per kilowatt-hour for all of the energy used for lighting, without regard to the maximum demand of each, but if the energy is used in motors the rate is only three cents per kilowatt-hour. Lighting rates in a certain large city range from eight to eighteen cents per kilowatt-hour, but at least one large consumer of electric energy in motors there gets current at the rate of two cents per kilowatt-hour. In another city, where the population is nearly one-third of a million, the lighting rate is fifteen cents per kilowatt-hour to ordinary consumers, but a large user of electric energy for motive power is supplied at less than one cent per kilowatt-hour.

Rates that vary with the maximum demand of each consumer are in effect rates that vary with the time of day when the energy is used to a large degree. This is because the greatest demand for light occurs between 4 and 8 P. M., and very few consumers use as much at any other time of day. In some cases the rate is made to depend directly on the hour of the day when the energy is used. Only three cents per kilowatt-hour is charged in a great city for energy used during certain hours of the night, though the rate at other times is ten cents.

A large manufacturing plant in a great city draws energy from the electric supply system at less than 0.6 cent per kilowatt-hour, but is not allowed to operate between 4 and 6 P. M.

NITRATES FROM THE AIR.

During the electrical congress held in St. Louis, 1904, a new method of oxidizing the nitrogen of the air due to Birkeland and Eyde was described. The electrical process of causing nitrogen and oxygen in the air to unite depends apparently upon the high temperature produced by the arc; but if the products of this action are allowed to remain in the arc they are separated again; therefore, to secure a high output for a given consumption of electrical energy, the oxides of nitrogen must be removed from the influence of the arc as soon as they are formed. Further, to secure a large output from each arc, a comparatively large volume of air must be exposed to its action. In the process referred to above, this is accomplished by striking an arc between two electrodes placed in a magnetic field. The current used is alternating, so that the deflecting action of the magnet blows the arc first to one side and then to the other.

In the description at St. Louis of the furnace, no data were given showing the performance of the furnace, though a little later a high efficiency was claimed for it. Recently, Professor Silvanus P. Thompson, discussing the production of nitrates from the atmosphere before the Royal Institution, of London, described in particular the results accomplished by the Birkeland and Eyde furnace. Unfortunately, the information obtainable is not quite as specific as could be desired. The furnace has been in use for some time in a research laboratory near Arendal, Norway, and its performance was so satisfactory that a factory was equipped at Notodden, where water-power is available and transportation arrangements convenient. Three furnaces were constructed, rated at 500 kilowatts each. Air is forced through them at about fifty litres per minute per kilowatt, the heat transferred to the resulting gases being abstracted under boilers for the production of steam. They are then passed through towers, where the nitric acid is abstracted, and is used in forming nitrate of lime.

Professor Thompson was not at liberty to give the exact results which he witnessed, but Mr. Otto Witt, a visiting expert, stated that the yield was between 500 and 600 kilogrammes of anhydrous nitric acid per kilowatt-hour and that not infrequently higher yields were observed. Taking the lower of the above figures, and assuming the cost of electrical power at 0.2 cent per kilowatt-hour, gives a cost of the pure nitric acid for electric power alone of about $36.50 per ton. Nitrate of lime containing thirteen per cent of nitrogen costs for power $22.50 per ton. It is said, however, that the power obtained from the waterfalls of Norway does not cost 0.2 cent per kilowatt-hour. In fact, a case was mentioned where a pulp mill sells its surplus power for about 0.094 cent with profit.

This is the most encouraging report of progress in the artificial production of fertilizer which has yet been made. The troubles up to this time have been due to the small output per arc, thus not only reducing the efficiency of the process, but making the output per cubic foot of space occupied small. More definite figures regarding the performance of this process, as it is worked on a commercial basis, and not experimentally, will be waited for with a good deal of interest.

UTILIZATION OF THE WATERS OF LAKE TITICACA, PERU.

BY EMILE GUARINI.

A visit was made recently by the author to the southern part of Peru, in order to explore the enormous hydraulic forces existing in that part of the country. It would seem that this section of Peru has a promising future before it, for the hydraulic power available is almost incalculable. At the present moment, however, all efforts seem to be concentrated in the mining and agricultural industries. This section of Peru may be described as an inclined plain commencing at the west side of the Cordillera, and extending from altitudes of three to four and even 5,000 metres to the Pacific coast at distances of about 150 kilometres. It is easily recognized that immense hydraulic power is available where the heights are so great, even though the amount of water be but small. For example, the river Rimac, which flows through the capital, Lima, descends more than 2,000 metres in a distance of 130 kilometres, and the flow at a minimum is about 500 cubic metres per second. It therefore represents theoretically 200,000 horse-power and could give actually at least 125,000 horse-power.

The question of hydraulic power development is, however, greatly complicated by other considerations, for the water of the rivers in this section of Peru is at the present time insufficient for the needs of irrigation. It is for this reason that the government has recently summoned specialists to report upon the sinking of artesian wells. Thus it is possible to utilize only partially the water for hydraulic power purposes.

With these considerations in mind, the author proposes the utilization of the water of lake Titicaca, the highest navigable lake in the world, and one of the largest of Peru or Bolivia. He further suggests that by such a development about 100 cubic metres of water per second will be available for irrigation purposes after it has passed through the turbines. It is not suggested that the waters of this beautiful lake, lying at an altitude of more than 3,800 metres, shall be drained. The lake has an area of 630 square kilometres and its mean depth is twenty metres. It therefore represents a volume of water of 503,880,000,000,000,000 litres, or a potential energy of 21,308,134 horse-power years. The idea is, on the other hand, to utilize a quantity of water which is at the present time lost partially by evaporation, but principally through filtration in the Pampa Aullagas, a second large lake. Lake Titicaca receives water from a number of rivers and it discharges in its turn into the Rio Desagadero, a river flowing through Bolivia. This river is 325 kilometres in length, and loses its water partially through evaporation, partially by filtration and finally discharges what remains into the Pampa Aullagas. The minimum flow is 100 cubic metres per second. The altitude of the last-named lake is 145 metres lower than Titicaca. It is a popular belief that this lake communicates with the sea by a subterranean canal, although it has been clearly shown that the water is lost by evaporation and filtration in the soil. The discharge from lake Aullagas is through a small river carrying only one cubic metre of water per second. It is evident that if one withdraws from lake Titicaca or the river Desagadero the greater part of the water which the former receives from its affluents, the speed of the water in the river, which is navigable, will diminish, and one will regain water at the present time completely lost in the Pampa Aullagas. After a careful study the author proposes that 100 cubic metres of water per second be withdrawn and precipitated on the Pacific side of the mountains. This may be utilized in one or a number of falls, and will then be available for irrigation on the Peruvian side. This amount of water would give theoretically 5,000,000 horse-power, of which 2,000,000 could be utilized. The distance from lake Titicaca to the Pacific is 150 kilometres in an air line.

As lake Titicaca is about 250 metres lower than the watershed of the mountains, the author proposes two methods of solution. The first is the simpler, though the more expensive. It is to drill a tunnel through the mountain. The second —less expensive, but apparently more complicated—is to pump the water electrically over the divide. The latter plan would call for a station capable of pumping water through a distance of 4,100 metres to a height of 250 metres, and would necessitate a steam pump to start the electric system. A good part of the work required to do this would be recovered by the fall on the other side of the mountain.

The enormous power thus produced can be utilized in many ways. The Southern Railway, of Peru, which at the present time expends $500,000 for coal each year, could be electrified. The power would be available in the mines, permitting the economical exploitation of many mines which have at the present time been abandoned for want of power. It would be available for electrometallurgy, making it possible to produce products of the highest value and saving enormously in the cost of the fuel, which now costs from $10 to $30 per ton. The power could also be used for agriculture, which is at the present time costly in Peru, the expense of cultivating one hectare being about $15 on account of many difficulties, particularly the lack of food for the oxen, or even of the oxen themselves. With electrical operation the expense would be reduced from $1 to $2 per hectare. Another application of electric power would be for telpherage—a simple, easy and economical method of transportation which could be exploitated largely for many mines and other industries, particularly agriculture, which at the present time is inactive for lack of means of communication where the traffic is insufficient to justify the construction of a railway or even of a tramway. Electric telpherage could be employed most advantageously

LAKE TITICACA, PERU.

throughout Peru in general, where roads and railways shine by their absence. The electric power would also be available for navigation on the rivers and lakes. It could be utilized for lighting the villages and for carrying on agricultural work at night, and it would be available in particular for supplying the power for large electrochemical industries, particularly near Mollendo, a port well situated for exportation by sea to Europe and to North and South America, and which is the terminus of the Southern Railway, of Peru. Among the different electrochemical industries the author suggests the electrolytic refining of copper, the extraction of gold and silver, the production of calcium carbide, of chemically pure electrolytic oxygen and hydrogen, and many other applications.

It is particularly desirable to establish the electrochemical industries, which turn out products of great value and small volume, and are hence easily transported. These would undoubtedly be remunerative. It is suggested, further, that the electrolytic production of nitrates be undertaken, for under exceptionally good conditions of operation this can be done at a less expense than that of securing the natural mineral in Chili. Peru would in this way extract from the atmosphere that valuable product which it lost in the unfortunate war with Chili.

If this project be carried out it would surpass any hydroelectric development which has up to the present time been undertaken. The turbines to be adopted would probably have a larger rating than those at Niagara, 13,000 horse-power, the height of fall would be the greatest yet utilized, and the voltage of transmission would probably surpass the 60,000 which is now utilized in the United States, notably in California. These features would all tend to diminish the cost of the first installation as well as the price of the power.

The author has made an approximate calculation of the expense of carrying out this work, with the result that the whole installation would cost $40,000,000, or about $20 per effective horse-power and $8 per theoretical horse-power. It is possible that it can be made lower than this.

If this gigantic project can be carried into execution it will surpass in importance Niagara, where the water can not be abstracted indefinitely without destroying these marvelous cascades. This projected development would not only be unique in its class, but would be the commencement of the exploitation of the enormous hydraulic forces of the Andes, and put Peru—a country so richly endowed by nature—on a level with the leading industrial countries of the world.

The Ondoscope.

An exceedingly simple device, known as the "Ondoscope," has been devised by Professor Ruhmer, of Berlin, for examining alternating or pulsating electric discharges. The following description is taken from the *Electrical Review*, London:

The principle of the apparatus is based upon the discovery by H. A. Wilson, in 1902, of the fact that the violet glow round the cathode of a Geissler tube varies in dimensions in proportion to the current strength, while it is, of course, free from inertia, and therefore follows changes in the current with absolute precision and instantaneity. The instrument devised by Ruhmer to take advantage of this phenomenon consists of nothing more than two wires sealed into an exhausted tube about a foot in length and one inch in diameter, with their inner ends close to a small hole in a mica screen. Viewed directly, when it is connected with the terminals of an induction coil, a steady violet glow surrounds the end of each wire; but when viewed in a revolving mirror, it is seen that the glow occurs alternately on the one and the other of the wires, never on both at once. Moreover, the luminous images, drawn out by the movement of the mirror, show by their outline the changes in the current strength with regard to time and in its direction. The effect of varying the frequency and duration of make and break, the potential difference applied to the primary coil and the nature of the secondary circuit can thus be studied with the greatest ease and convenience. On inserting a Villard valve-tube in the high-pressure circuit, the current becomes unidirectional, though, of course, still intermittent. Using the ondoscope in series with an X-ray tube, with a valve-tube in circuit, the strength of current can be estimated, or even roughly read off on a scale, with the instrument; the latter also serves to verify the fact that all the discharges occur in one direction only, testifying to the efficacy of the valve-tube, which exercises an extraordinary powerful action as a rectifier. A singular fact which is shown by the ondoscope is that the discharge through an X-ray tube is practically instantaneous, the luminous image consisting simply of a narrow streak, no matter how rapidly the mirror was turned. By photographing the images a permanent record can, of course, be obtained.

The ondoscope operates with about 300 volts potential difference, so that it is available for use on ordinary high-pressure alternating circuits; while it is lacking in some of the advantages of the oscillograph, it unquestionably yields a considerable amount of information regarding wave-form, oscillations, etc., with the minimum of trouble and expense, and it can hardly get out of order.

The New York Railroad Club.

The second annual electrical night of the New York Railroad Club was held March 16 at Carnegie Hall, New York city. The meeting was called to order by President H. H. Vreeland, and a paper read by Mr. B. G. Lamme, Pittsburg, Pa., entitled "Alternating-Current Electric Systems for Heavy Railway Service."

Mr. Lamme described briefly those alternating-current systems which have been carried to the experimental stage. The first of these—that most generally employed in this country—is the so-called alternating-current-direct-current system. The power is transmitted by high potential, three-phase, alternating currents from the main power-house to substations, where rotary converters transform it into direct current at a potential suitable for use on the cars. The drawbacks to this system are the great cost, both for the first installation and for operation. The moving machinery at the substations necessitates constant attendance. The second system does away with the stationary substations by placing converting machinery upon the locomotives or upon a tender to be attached to the locomotives. The locomotive then collects its power from a trolley wire at high potential and converts it into direct current at a potential suitable for the motors. This system has some distinct advantages: the transmission plant is not expensive and the control of the locomotive is excellent. It can not, however, be used for motor cars as distinguished from locomotives, and even for the latter the weight of the equipment is a great drawback. The cost of the locomotives is also high.

The third system—but little used in this country, though to a larger extent in Europe—is the polyphase system, polyphase induction motors being employed to propel the locomotive. The objections to this system are the necessity for at least two overhead wires and the fact that the induction motor is a constant-speed machine. This makes speed regulation difficult without great waste of power and renders possible an excessive overloading of the motors due to unbalancing caused by difference in the diameter of the driving wheels.

The Arnold electropneumatic system, referred to briefly, consists in employing a single-phase motor to drive the car, speed control being obtained through an electropneumatic coupling device.

The system to which particular attention is directed to-day is what is now called the single-phase system. In this

power is transmitted at a high potential by means of a single overhead wire, is collected by the locomotive or by the cars, and by means of transformers on the cars is lowered to a potential suitable for the motors. This system has but one overhead wire; it employs motors having the characteristics of the direct-current series motor; it enables an efficient method of speed control to be obtained, using for this purpose the lowering transformer. The motors may, if desired, be employed for braking the locomotive or the car, and they may even return power to the line. Experiments have shown that this can be done at any speed, and the controlling apparatus enabled the rate at which power was returned to the line to be governed at any of these speeds.

Mr. Lamme then described briefly some of the features of the New York, New Haven & Hartford equipment and of the Sarnia tunnel equipment. An abstract of this portion of the paper will be found on another page of this issue.

Mr. Lamme was followed by Mr. W. R. Cooper, of Pittsburg, who showed a number of lantern slides of the New Haven locomotive, and explained the mechanical and electrical features of the design.

The discussion was opened by Mr. W. J. Wilgus, vice-president of the New York Central & Hudson River Railroad Company, who said that there could be two reasons for adopting electricity on a steam railroad. The first was when the change was brought about in order to do away with smoke in a tunnel or on account of city ordinances, the other was when an improved service might be secured in this way. A change of system involves certain responsibilities, for the danger to employés of the road and passengers must not be greater in the new than in the old system. He did not think that either the third-rail system or the overhead trolley system was any more dangerous to passengers and workmen than the old steam system. With the third-rail system there is some danger to trackmen and to trespassers on the road. With the trolley system there is some danger to freight hands on the cars. The third rail can be protected so as to be reliable during sleet or snow storms. Both of the methods of collecting power are necessary for electrical development, but it seemed to him that the preference lies with the third rail. The necessary feature of any change in system is that the new must be at least as reliable as the old. To this end a number of power stations seem better than one. Another essential feature is that the working conductor shall not be the transmitting conductor. It must be possible to cut out at any time any section of the working conductor without affecting any other section. Storage batteries are necessary as an insurance against interruption; and for suburban traffic the multiple unit system, doing away with switching and the necessity for running long trains, seems to be the best.

Mr. Calvert Townley, New Haven, Ct., in presenting the advantages of the electric system, called attention to the limited capacity of the steam locomotive which is set by its ability to generate steam. The electric locomotive, on the other hand, can be said, in a way, to have a capacity for doing work limited only by the ability of all the firemen in the central station to shovel coal. This increase in capacity obtained with the electric locomotive makes possible an increase in the track capacity of a system which, in some cases, is essential for expansion. This is true of a system which, on account of its location, can not secure ground for an additional track. As regards the New York, New Haven & Hartford road, there are certain peculiarities which led to the adoption of the single-phase system. The New Haven system is a network covering a thickly settled manufacturing country, and there is a possibility of obtaining cheap power. Moreover, this company operates a number of tributary electric lines, which may in the future become branches of the main road. The system adopted must therefore be one which can in the future meet these requirements.

As regards the reliability of the single-phase system, it seems that this should be greater than a rotary-converter system, since in the former case there is but one link between the generating station and the locomotives. In the latter case there are seven or eight links. The single-phase system has the great advantage of being less expensive to install and less costly to operate. A point sometimes overlooked is that there is no necessity to carry a high potential over all parts of the line. It is a simple matter to step down at any point to any desired lower potential, or even to go higher, if thought desirable, and at the end of this section to transform back to the standard.

Mr. Frank J. Sprague, New York city, said that the main consideration in any case of transformation was one of dollars and cents. The new system must save in the cost of operation or must, by increasing the traffic of the road, offset any increase in this cost. To this end the multiple unit system, by making increased facilities possible, should increase correspondingly the traffic of the road. Mr. Sprague does not think that the number of links between the generator and the car or locomotive is a source of weakness. As regards electrolysis, there is little opportunity for this on a well-constructed roadbed—less, in fact, than might be expected from an alternating system with a large drop of potential in the ground return. This drop in the ground may influence telephone and telegraph lines. To secure reliability, a number of independent generating stations are essential. A feature of the alternating-current system is the greater apparent resistance in the overhead conductors than in the rails. On an average this would be about six and one-half times what it would be for direct currents. Mr. Sprague believes that the cost of the third rail is less than that of the span bridge and catenary method of suspending the overhead conductor. He said that the alternating motor gives a pulsating torque; therefore, with a given weight on the drivers, the effective tractive effort must be less than with a direct-current motor which gives a constant torque. He pointed out the fact that the New York Central locomotives are rated at 2,200 horse-power, while the New Haven locomotives, weighing about the same, are rated at only 1,000 horse-power.

Replying to the discussion, Mr. Lamme said that no comparison between alternating-current and direct-current systems had been made in his paper. He has merely given the reasons for adopting the alternating-current system for the New Haven road. While agreeing with Mr. Sprague as to the apparent increase in the resistance of the overhead and ground return for alternating current, as compared with direct current, he pointed out that with a high-potential, alternating-current system of 11,000 volts, the current transmitted would be much less than that of the 600-volt, direct-current system, and the advantage would therefore rest with the alternating. Tests had been made to determine the effect of the pulsating torque on the tractive effort, and it was found that there was little or no difference. In some tests no difference whatever was observed when operating the motors on alternating and on direct currents. In other cases a difference of about fifteen per cent had been observed. The average would not be more than five per cent. It seems that the elasticity of the locomotive absorbs the variations in the motor effort. These tests have been conducted with various frequencies. With twelve cycles per second the effective effort was less than with twenty-five, but when the frequency was raised to only fifteen cycles per second, the performance of the locomotive was as good with alternating as it was with direct currents, and he thinks no trouble need be expected from this source.

The meeting then adjourned.

Two Interesting Tyrol Hydroelectric Plants.

By Franz Koester.

HYDROELECTRIC PLANT "MALSERHEIDE," NEAR GLURNS, TYROL (4,750 FEET ABOVE SEA LEVEL).

TO supply a number of small towns with power as well as with light the water power of the river Etsch is utilized, thus adding one more to the already long list of hydroelectric plants in Tyrol supplying small communities. After leaving the Heidersee, the lower of the three Etsch lakes, some 4,750 feet above the Adriatic sea level, water was taken at a dam, already constructed for irrigation purposes, for the power plant, and then carried through the supply channel, partly in the form of an open dish and partly as a tunnel, to the collecting basin, a total distance of 2,300 feet. The entrance to this channel is well protected by a rough screen installed in two sections, some thirteen feet long each, supported at the centre and ends by concrete piers. At the side of these screens, likewise supported by concrete piers, is a six and one-half-foot sluice-gate for regulating the flow of water. As the supply inlet is raised thirty-two inches above the concrete floor of the river at this point, a large proportion of the sand and gravel is collected before the water enters the race. This deposit is removed by opening the sluice-gate at the bottom. Here also is provided an overflow, as will be seen in Fig. 1. After flowing through the supply channel, before entering the collecting basin, the water has to pass a fine screen, where provision is also made for collecting the fine sand which may have been carried along with the water and which is discharged into the waste channel. This basin is of concrete construction, the screens and gate being covered by a small wooden structure. A penstock three and one-half feet in diameter and about 160 feet long, made up of riveted steel pipe sections, leads down the mountain side to the power-house. The power-house is designed for the accommodation of three 230-horse-power units, only two of which, however, are at present installed. Although more power was available, it was deemed unadvisable to install a larger plant on account of the high altitude of the location and the consequent difficulty of disposing of all the electric power generated, thus diminishing the dividends on the plant.

The building up to the engine room floor is of concrete, while above this level it is constructed of brick, with a peaked roof covered with tiles. On one side of the building is a small switching house, while on the opposite side are rooms for employés as well as an office and a repair room. Fig. 2 gives an illustration of this building, in the rear of which, high up on the mountain, will be noticed the small wooden structure covering the collecting basin. The penstock enters at the side

FIG. 1.—DAM AND SLUICES OF HEAD-RACE, "MALSERHEIDE" HYDROELECTRIC PLANT.

FIG 2.—EXTERIOR OF POWER PLANT, "MALSERHEIDE" HYDROELECTRIC PLANT.

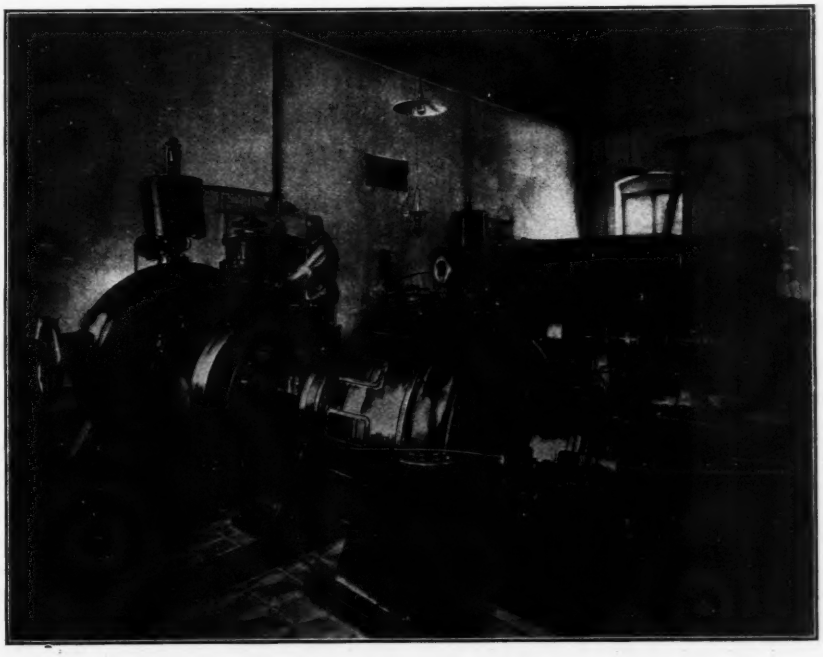


FIG. 3.—INTERIOR VIEW, "MALSERHEIDE" HYDROELECTRIC PLANT.

of the power-house directly under the turbines below the basement floor, from where branches are taken off at ninety degrees to the turbines. Gate valves are located in these connections, which make it possible to cut the turbine off from the penstock. These machines are of the Francis spiral type, with horizontal shaft. The water is discharged through a well-submerged draught tube into the tail-race, this latter lying directly below the chamber containing the penstock. The turbines make 600 revolutions per minute and have a capacity of 230 horse-power each. The regulation of the speed of these turbines is accomplished either by hand or by mechanical means. Pressure water from the penstock, after passing a very fine screen, is used in the servo-motor for operating the governor mechanism. Besides this there is a flywheel mounted on the main shaft at the side of the turbine. The latter was found necessary, as the momentum of the small generators would have been insufficient to maintain a uniform speed. The generator and turbine shafts are connected by means of flexible isolated leather belt couplings. Penstock and turbines as well as the necessary mechanical equipment were contracted for by the Prager Maschinenbau-Gesellschaft, in Prag, Austria.

The generators are of 155-kilowatt capacity, producing current at 5,000 volts and fifty cycles per second. Overhanging upon the main shaft is mounted an exciter, as will be seen in Fig. 3, the capacity of which exciter is sixty amperes at sixty volts. The generator leads are laid in a covered trench under the engine room floor. The switchboard is made of white marble, mounted on an angle-iron frame, and is equipped with all measuring, switching and synchronizing apparatus necessary for the convenient and efficient operation of a modern power plant. There is no high-tension apparatus mounted on the main board, as step-down transformers are interposed between the line and measuring instruments. The exciter field rheostats are so connected that, in synchronizing, they may be operated independently or simultaneously.

As previously stated, the power-house is located very high up in the mountains, making access very difficult. On account of this the cost of fuel for heating purposes is prohibitively high and, as the available water power was far in excess of that required, it was decided to heat the plant and annex buildings entirely by electricity. This is done through one thirty-two-kilowatt transformer, which at the same time furnishes current for lighting. From the power-house two main two-wire feeders are taken, mounted on high-tension insulators on wooden poles. One runs north along the shore of the Heidersee to Reschen and the other southwesterly via Glurns to Laas. Altogether there is a total of thirty kilometres (eighteen miles) of distributing feeders. The entire equipment is well provided with safety devices, such as lightning arresters and similar apparatus for protecting the line from atmospheric disturbances, common in mountainous districts, especially where the difference in altitudes is great, as in this case, more than 2,000 feet. There are at present twenty-two transformer substations, most of which are constructed of iron, where the voltage is stepped down from 5,000 to 250. The total normal capacity of these transformers is 200 kilovolt amperes. This current is used entirely for lighting, except for a few instances where power is used to operate motors running agricultural machinery. The power rate of $4 per horse-power per year is so low that the small farmer may advantageously use electric motors. Although this is an exceedingly low price for power, there are many similar plants in operation on the Continent of Europe, especially in Switzerland and Tyrol, giving a widespread community the opportunity of utilizing electricity for lighting and agriculture.

HYDROELECTRIC PLANT, "RIENZWERKE" OF THE CITY OF BRIXEN, TYROL.

In 1901, the one thousandth year of its existence, the town of Brixen decided to build its own electric light and power central station. For this purpose the river Rienz was harnessed at a point one and one-quarter miles below the junction of the Valser. At this point the river is raised by a dam about six feet high, as illustrated in Fig. 4. The supply channel, after a run of about seventy feet, is fitted with three rough rectangular racks supported between granite piers, over which is placed a wooden structure to facilitate the cleaning of these racks, which are supported at an angle. Owing to the character of the mountain stream, which carries along much foreign material, such as gravel, etc., a sluice-gate eleven and one-half feet wide is provided near the river bed. The entrance of the supply channel is equipped with a double-door sluice-gate. Special traps are also provided here to prevent floating sand, gravel and other foreign substances from entering the channel. Immediately below this is a fine screen, as a still further protection, to catch any substances which may have passed the above-mentioned rough racks and traps. The channel itself is six feet wide and 9.8 feet deep, and its total length is approximately three-quarters of a mile. At the end of the channel a collecting basin sixty feet long and some forty-eight feet wide is located. This basin is constructed entirely of concrete and is provided with a roof of wooden construction. As will be seen in Fig. 5 it is located in the rear of the power-house. As each turbine has its own individual penstock, this collecting basin is divided into three chambers. Before entering these chambers the water has to pass over a small offset and also through additional fine screens, so that all sand, etc., is positively removed before the penstock proper is reached, and practically no possibility of sand entering the turbine exists. On the side opposite to the penstock connections is an overflow dam, and should any repairs or emergency require it, all the water can be passed through a sluice directly into the waste outlet falling in cascades down to the river below the power plant.

Provision is made for three penstocks, only two of which, however, are at present installed, any one of which may be closed by sluice-gates at the collecting basin. The penstock has a diameter of 4.7 feet and is made up of sections about thirty feet long, with bolted flange connections. Each section consists of three lap-riveted courses. The penstock is 170 feet long and is inclined at an angle of approximately twenty degrees, a slip joint being provided near the top to take up expansion. At the power-house end the penstock is rigidly imbedded in a heavy concrete foundation.

The power-house itself is a brick structure, and the clear dimensions are seventy-five feet by thirty-five feet. The roof consists of steel trusses with wooden planking. The plant is equipped with a seven and one-half-ton overhead hand-operated traveling crane.

At one end of the building is a room set apart for switching and measuring apparatus, while at the other end is a dwelling compartment for the superintendents, which contains also a repair shop and an office. Although the building is of simple design, its pleasing architectural features are easily noticeable in Fig. 5. As already mentioned, the building is equipped for three 900-horse-power turbines, only two of which are at present installed. The penstock is connected to the turbine through a butterfly valve.

The turbines are of the twin or double

Francis type. The water entering the turbine chamber flows through two runners and discharges through a common conical draught tube, which is well submerged below the tail-race. Each machine is well equipped with delicate regulating devices, as will be seen in Fig. 6. The turbines were built and installed by the Prager Maschinenbau-Aktiengesellschaft vorm, Ruston & Company, of Prag.

The generators are connected to the paratus located on the opposite side of the wall in the switching room. The measuring instruments are mounted on white marble panels facing the main generator room, while the high-tension switches located in the opposite room are operated at the main board by means of chains and levers. There is no high tension on the switchboard, as transformers are interposed between the measuring instruments and the high-tension buses. For throwing the generators in parallel a small electric motor, operated from the switchboard, is connected to the governor. There are at present two sets of line feeders, one underground and the other overhead. The former is an insulated cable, while the latter is a bare one. Current is fed over an extended area through numerous transformer stations at a secondary potential of 150 volts, supplying twenty-six arc lamps and 250 incandescent lamps for public use and 7,000 incandescent lamps for private use.

As the plant lies in a ravine of the Tyrol Alps and the distribution feeders run partly through this valley, the atmosphere of which is generally at a very high temperature, and at the same time over a high, rough mountainous country, often visited with violent cold winds at high velocity, the differences of temperature frequently cause such enormous static atmospheric discharges as to produce great strains on the generators, not seldom bringing them to a complete standstill. This occurred in spite of the fact that the entire installation was well provided with lightning arresters. Special additional lightning arresters, however, have been installed, and the inconvenience of having the service interrupted has now been entirely done away with.

The mechanical equipment of the plant was furnished and installed by the Prager Maschinenbau - Aktiengesellschaft, while the entire electrical installation was made by the Siemens-Schuckert Werke.

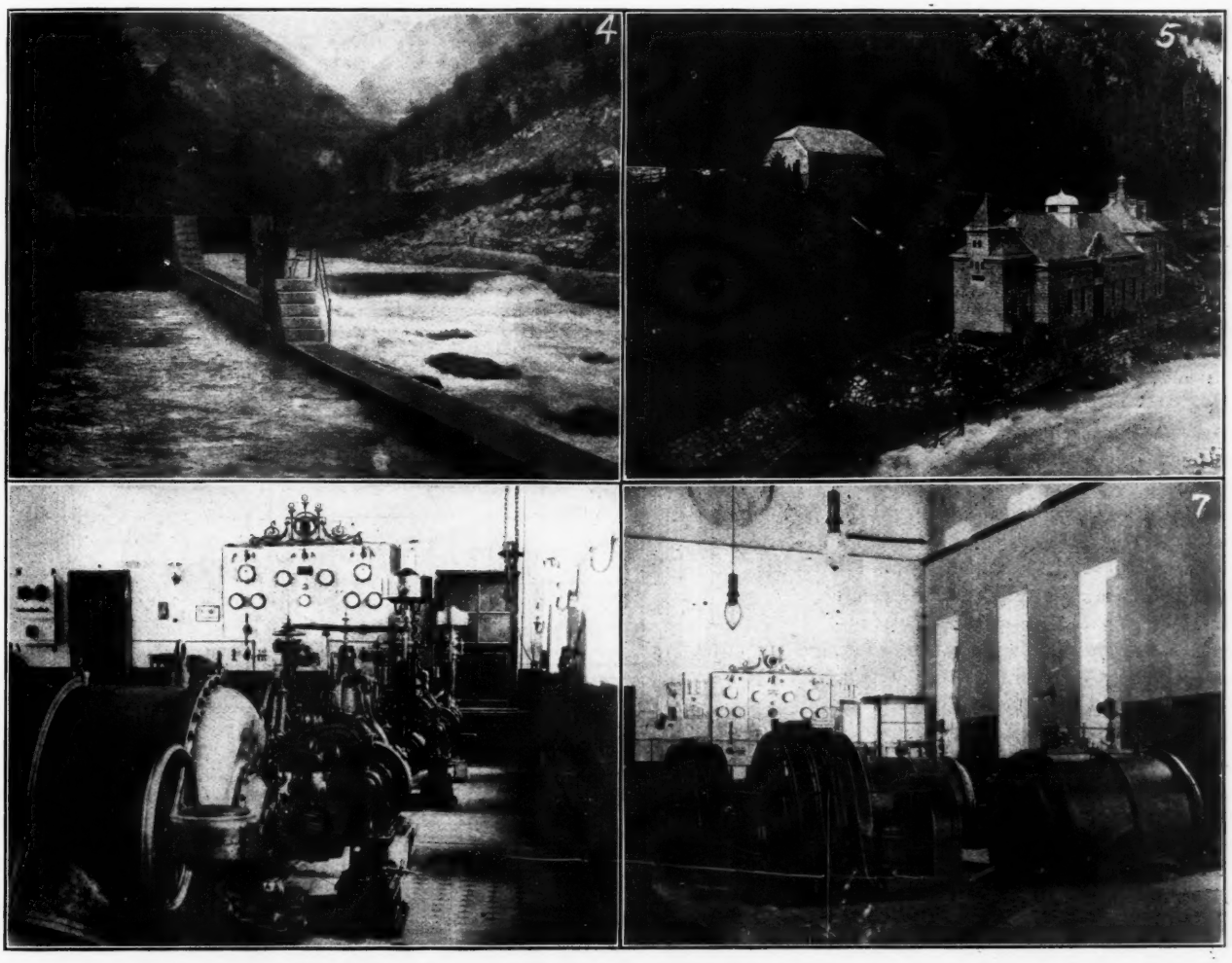


FIG. 4.—DAM AND SLUICES OF HEAD-RACE. FIG. 5.—EXTERIOR VIEW OF STATION. FIG. 6.—INTERIOR VIEW OF GENERATING ROOM.
FIG. 7.—VIEW FROM OTHER SIDE OF GENERATING ROOM. "RIENZWERKE" HYDROELECTRIC PLANT.

shafts of the turbines by flexible isolated leather belt couplings. The generators are of the three-phase alternating-current type, 5,000 volts at fifty cycles per second. The generators are of the revolving field type with laminated armature and poles, the magnet yoke being of cast iron and the rotor of cast steel. The exciter is mounted directly on the main shaft, as seen in Fig. 6.

The switchboard, composed of three generator panels, is mounted against the end wall of the generating room with the ap-

Calculations and Requirements for Central Station Heating.

For some time the question of central station heating has received the conscientious study of many central station managers and independent engineers. The advantages of a heating load for many central stations have been pointed out from time to time, and where this form of residence and building heating is feasible, the profits to the central station in many instances has been well worth the initial expenditure. One of the most successful heating systems which has been devised is the Schott balanced water column system for central station heating. The data given herewith are the result of painstaking study and great ingenuity on the part of William H. Schott, Chicago, Ill. These data were presented last year in an address before the Robert Fulton Society, at Chicago.

A central station heating plant, in order to work economically and give satisfactory results, requires that the closest attention be paid to its design, as the heating plant generally operates in connection with a power plant. Flexibility and economy are the most essential features.

The diagram herewith (Fig. 1) represents a modern combination plant on the Schott system. It will be noted that this is a typical layout, where the engines are used for driving generators. The exhaust from the engines is used in surface condensers for heating circulating water, which is distributed by means of pumps. After the latent heat of the exhaust steam has been absorbed by the circulating water, it is forced through direct-fired boilers to bring the water to the proper temperature, provided the exhaust steam is insufficient, then going to the buildings to be heated. In other words, the engine plant is operated in series, each part of the apparatus performing its part of the work, the condensers transmitting the latent heat from the steam to the water, any deficiency being made up by the direct burning of coal under the boilers.

It has been demonstrated, Mr. Schott declares, that fifty-five pounds of coal burned under the boiler will deliver the same heat units to the circulating water as 100 pounds of coal will deliver when used for the purpose of generating steam and then turning the steam into the condensers. During the time the boiler is being utilized as a circulator, it acts merely as an economizer, due to the low temperature of the circulating water, and the absorbing power of the boiler is very high.

In order at all times to check up each

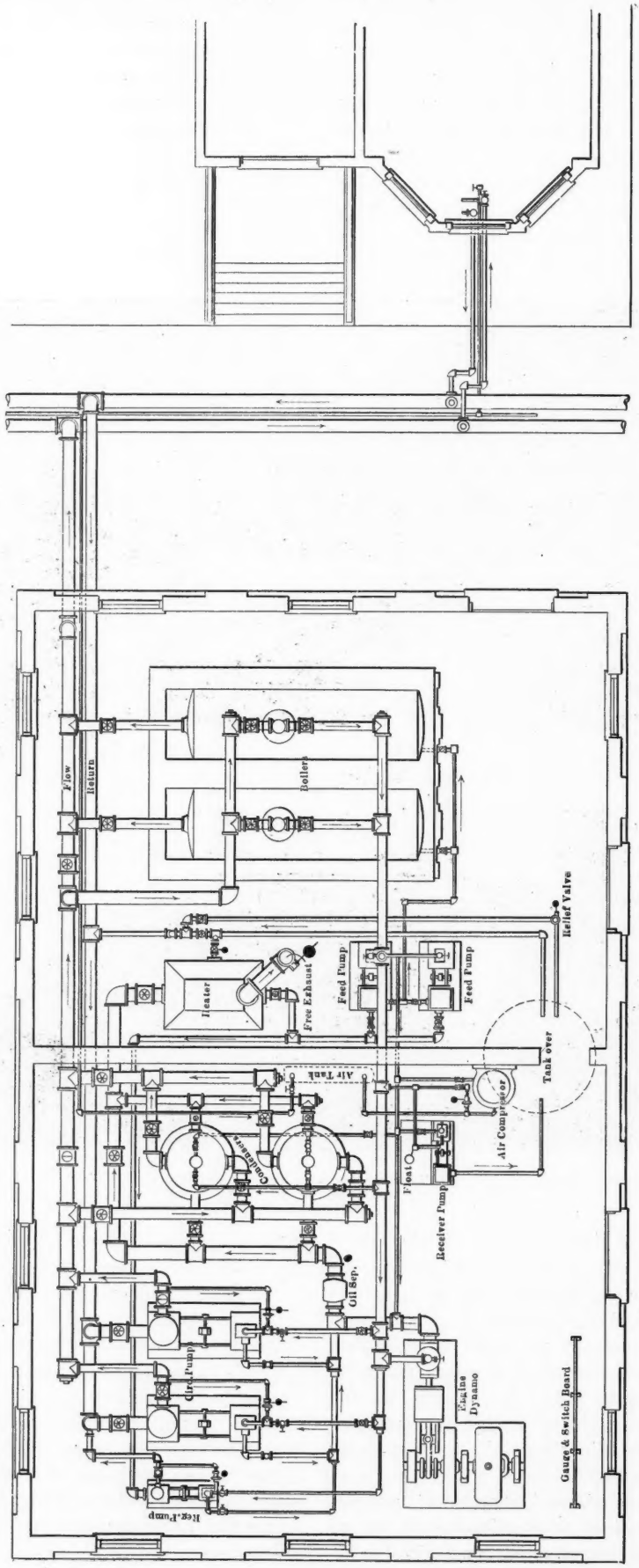


FIG. 1.—PLAN OF STATION PIPING, AND STREET AND RESIDENCE CONNECTIONS, BALANCED COLUMN HOT WATER SYSTEM.

factor in the operation of the plant, a well-equipped gauge board is necessary.

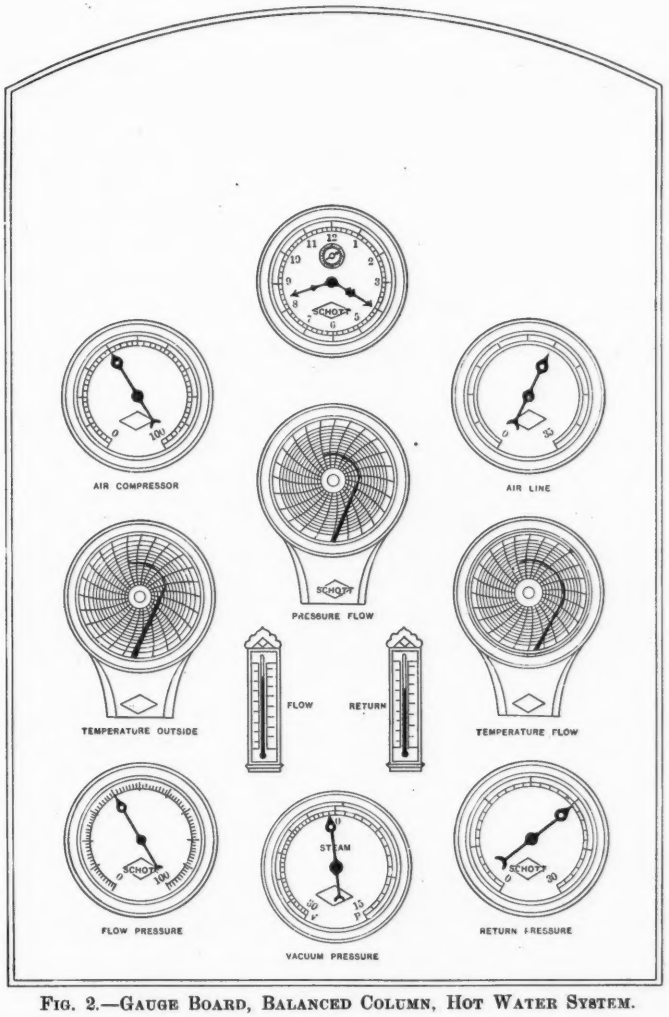


FIG. 2.—GAUGE BOARD, BALANCED COLUMN, HOT WATER SYSTEM.

Fig. 2 shows a typical board, upon which are mounted a complete set of direct-reading instruments, as well as a complete set of recording instruments. These will record the outside temperature, the temperature of the supply water, the temperature of the return water, together with the steam pressures.

A typical condenser used in central station work is shown in Fig. 3. This machine has a steel shell with a water chamber top and bottom, the tubes being expanded in solidly. The expansion and contraction is taken care of by a diaphragm in the centre of the shell. The upper and lower water chambers are fitted with manholes of the "Eclipse" pattern, permitting ready access for inspection or cleaning out.

A typical form of expansion joint is shown in Fig. 4. This is designated as the "slip" type, the body being made up of cast iron. The sleeve is made up of either brass or gun metal. The packing is metallic, and the form it will take is governed by the pressure of the service and by whether steam or water or other liquids are to be taken care of.

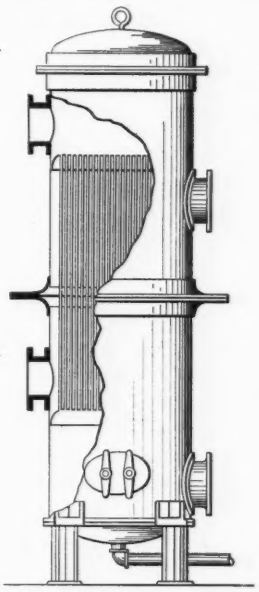


FIG. 3.—SPECIAL HEATING CONDENSER.

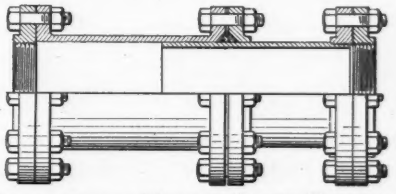


FIG. 4.—SPECIAL METALLIC PACKED EXPANSION JOINT.

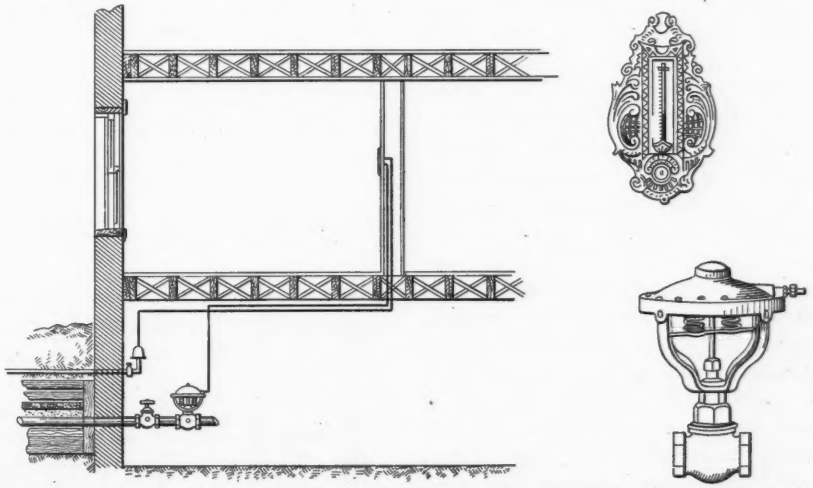


FIG. 5.—DIAPHRAGM VALVE AND THERMOSTAT, AND METHOD OF MAKING RESIDENCE CONNECTION.

In Fig. 5 there are shown the elements of the Schott regulating system. It will be noted that the diaphragm valve is placed upon the service pipe where it enters the building. The valve is controlled by a constant pressure of compressed air admitted to it through the thermostat.

One of the features of this system is regulation, affording a uniformity of control which is essential in central station heating systems. Table I herewith represents a test made on a plant operating with and without regulation. Taking the

top line, it will be noted that with two pumps in service and the mean effective steam pressure on the pistons at 27.5 pounds, the water pressure maintained was thirty pounds.

Horse-power of steam required	9.92
Horse-power of water cylinders	7.91
Per cent friction	25.4
Per cent efficiency	79.7
Gallons pumped per hour	27245.0
Feet of radiating surface connected	28125.0
Gallons per foot per hour	0.97

The above figures were obtained with the regulators in action. The regulation was then closed off and a test without regulation made, with the following results, two pumps being in service:

Mean effective pressure on piston	29.0 pounds.
Water pressure maintained	30.0 "
Horse-power of steam required	13.7
Horse-power water cylinders	11.3
Per cent friction	24.0
Per cent efficiency	82.5
Gallons of water pumped per hour	40128.0
Gallons required per foot per hour	1.42

From these data it will be observed that there is considerable difference in the capacity of the plant operating with and without regulation. This test was made at a time when the thermometer was very close to zero.

In figuring upon any heating propositions, the amount of radiation that a given-sized pipe line will take care of at a given velocity is always an interesting problem. Table II shows the radiation and loss in pressure at six pounds of water per hour per foot of radiation. As to the velocity permitted this will depend upon whether the pipe in question is a supply pipe or a distributing main. A heating plant must be designed from a capacity standpoint to take care of the required connected load at the minimum outside temperature; consequently, in arriving at pipe line requirements, all of these facts must be taken into consideration. As the maximum requirements exist only about five per cent of the season, a sacrifice can be made during this period in order to keep down the investment. It is usual then to consider both maximum and average conditions to arrive at the size of pipe that should be installed.

Table III shows what can be done with 100 horse-power under varying conditions. In the steam plant, assuming the outside temperature to be fifty degrees Fahrenheit, 100 horse-power would supply heat to 43,000 square feet of water radiation. The same horse-power in a fire-tube boiler would supply 37,300 square feet of water radiation. Applying this to a steam plant, the water-tube boiler would take care of 25,000 square feet of surface, while the fire-tube boiler would take care of only 18,200 square feet. Taking the same capacity, and assuming ten degrees below zero as the outside temperature, in a water plant 100 horse-power would take care of, in a water-tube boiler, only 18,400 square feet, while the same horse-power in a fire-tube boiler would take care of only 15,500 square feet. Under steam conditions it would take care of 8,400 square feet in the first as against 7,560 square feet in the second case.

With zero temperature outside, in a water plant the standard temperature of surface would be 190 degrees. At this temperature each square foot would transmit 221 heat units per hour, 5,304 heat units per day, or, upon this basis, would require 1,168,880 heat units per season, upon a heating season of 5,280 hours, using slack coal with a calorific value of 10,500 British thermal units, the plant being designed for sixty per cent efficiency, the temperature of the buildings to be maintained at seventy degrees Fahrenheit.

TABLE I.—TEST ON HEAT REGULATION.

No. of Pumps. With Regulation	No. of Pumps. Without Regulation	M. E. P. on Piston.	Water Pressure.	Strokes per Minute.	H.-P. Steam.	H.-P. Water.	Per Cent Friction.	Per Cent Efficiency.	Gallons per Hour.	Sq. Feet of Radiation.	Gallons per Foot per Hour.
2	..	27.5	30.0	12.9	9.92	7.91	25.4	79.7	27245	28125	0.97
..	2	26.0	29.0	18.4	13.4	10.6	26.4	79.1	38856	28125	1.38
..	2	29.0	30.0	19.0	13.7	11.3	24.0	82.5	40128	28125	1.42
..	1	29.0	29.5	18.6	15.1	11.2	34.5	74.4	39282	28125	1.39
1	..	27.5	30.0	11.3	8.72	6.9	26.0	79.3	23865	28125	0.85

TABLE II.—RADIATION AND LOSS IN PRESSURE AT 6 LBS. WATER PER HOUR PER FOOT RADIATION.

Size of Line.	120 Ft. per Min.	Drop per 100 Ft.	180 Ft. per Min.	Drop per 100 Ft.	240 Ft. per Min.	Drop per 100 Ft.	300 Ft. per Min.	Drop per 100 Ft.	360 Ft. per Min.	Drop per 100 Ft.	420 Ft. per Min.	Drop per 100 Ft.	480 Ft. per Min.	Drop per 100 Ft.
1	406	1.50	620	3.00	825	5.00	1026	8.00	1040	10.2	1443	16.5	1648	20.8
2	1640	0.77	2450	1.68	3270	1.81	3988	4.01	4906	5.58	5725	7.50	6444	10.4
3	3681	0.51	5520	1.05	7375	1.77	9190	2.66	11065	3.75	12875	6.80	14720	6.9
4	6500	0.38	9815	0.79	13065	1.33	16375	2.00	19625	2.85	22875	3.75	26144	5.2
5	10190	0.31	15315	0.64	20500	1.06	25500	1.60	30640	2.25	35750	3.00	40856	4.2
6	14690	0.26	22065	0.53	29450	0.88	36815	1.30	44190	1.80	51500	2.00	58856	3.5
8	26190	0.19	39250	0.39	52315	0.66	65625	1.00	78125	1.35	91250	1.80	104288	2.6
10	40875	0.15	61375	0.31	81875	0.53	101875	0.80	122500	1.01	143125	1.50	163576	2.1
12	58875	0.13	88125	0.26	117500	0.49	145875	0.66	176875	0.90	206250	1.20	235712	1.7
14 O.D.	66000	0.128	99600	0.225	132600	0.44	165600	0.57	199200	0.80	232200	1.05	264000	1.6
15 O.D.	76800	0.118	115200	0.20	153600	0.41	192600	0.53	231600	0.74	269400	0.98	306000	1.5
16 O.D.	88200	0.11	132600	0.195	176400	0.38	220800	0.49	265200	0.69	309000	0.91	348000	1.4

TABLE III.—RADIATION SUPPLIED BY 100 H.-P. BOILER CAPACITY AT VARIABLE TEMPERATURES.

WATER.					STEAM.				
Temperatures.		Radiation per 100 H.-P.			Temperature and Amount.			Radiation per 100 H.-P.	
Outside Temperature.	Water Temperature.	Water Tube Boiler.	Fire Tube Boiler.	Exhaust Surface Condenser.	Outside Temperature.	Steam per Foot per Hour.	Steam per Season of 5000 Hrs.	Water Tube Boiler.	Fire Tube Boiler.
50°	140°	43000	37300	22600	50°	.117	585	20250	16000
40°	150°	36500	31000	19300	40°	.138	690	16400	14850
30°	160°	31900	27200	16770	30°	.16	800	14000	12600
20°	180°	25000	21500	14700	20°	.20	1000	11250	10000
10°	190°	22300	19000	13000	10°	.225	1125	9990	9000
0°	200°	20000	17400	11500	0°	.25	1250	9000	8100
-10°	210°	18400	15500	10500	-10°	.265	1325	8400	7560
-20°	220°	16500	14300	9600	-20°	.303	1515	7500	6750
-30°	230°	15000	13000	8600	-30°	.333	1665	6750	6000

Table IV gives coal consumption at various temperatures, this table being based

TABLE IV.—COAL CONSUMPTION AT VARIOUS TEMPERATURES.

Mean Temperature of Water.	Outside Temperature.	Heat Units per Hour.	Heat Units per Day.	Heat Units per Season.	Pounds Coal per Hour.	Pounds Coal per Day.	Pounds Coal per Season.
220°	-30°	306	7344	1615680	.047	1.128	248.16
212°	-22°	280	6720	1478400	.044	1.056	232.32
210°	-20°	275	6600	1452000	.0437	1.049	230.74
200°	-10°	246	5904	1298880	.0390	0.936	205.92
190°	0°	221	5304	1168880	.0351	0.842	185.32
180°	10°	195	4680	1029600	.0310	0.744	163.68
170°	20°	170	4080	897600	.0270	0.648	142.56
160°	30°	146	3504	770880	.0232	0.556	122.32
155°	35°	136	3264	719180	.0216	0.518	114.05
150°	40°	124	2976	654720	.0197	0.472	103.84
140°	45°	102	2448	538560	.0162	0.388	85.36
130°	50°	82	1968	432960	.013	0.312	68.64
120°	55°	66	1584	355480	.0104	0.249	54.78
110°	60°	51	1224	269280	.0081	0.194	42.68
100°	65°	44	1056	232320	.0070	0.168	36.96

0.035 pound of coal per hour, 0.842 pound of coal per day, or 185.32 pounds per season.

Taking Chicago, Ill., with an average heating season of approximately thirty-five degrees, the following figures will be practically standard for a first-class water plant:

Average outside temperature.....	35.0 degrees.
Average temperature of service..	155.0 "
Heat units emitted per hour	136.0
Heat units emitted per day.....	3284.0
Heat units emitted per season	719180.0
Pounds of coal per hour.....	0.0216
Pounds of coal per day.....	0.518
Pounds of coal per season.....	114.05

From actual tests made throughout the past season the above tables are found to be about correct when applied to radiation figured upon a basis of maintaining seventy degrees Fahrenheit with 100 degrees difference between the inside and outside temperature as a maximum.

Table V shows the steam consumption of both simple and compound engines under varying conditions. Very often, in considering a central station layout, the engineer discovers compound engines which have been operating under vacuum conditions. To change these engines from condensing to non-condensing would mean to increase the steam consumption per indicated horse-power-hour. All of this increased consumption is directly chargeable to the heating department and must be known in order to determine, from a boiler standpoint, just what surface must be provided for. Assuming a compound engine of standard make, with a twenty-six-inch vacuum, consuming sixteen pounds of steam per indicated horse-power-hour, it is found from this chart that to operate the same engine with a condenser at atmospheric pressure would increase the steam requirements per indicated horse-power-hour six pounds. In other words, it would take twenty-two pounds of steam per horse-power-hour, as against sixteen pounds with a twenty-six-inch vacuum. If the engine were a simple engine at twenty-six-inch vacuum, and it was consuming twenty-five pounds of steam per horse-power-hour at atmospheric pressure, it would consume thirty pounds.

TABLE V.—STEAM CONSUMPTION PER I. H. P. AT VARIABLE BACK PRESSURES

Back Pressure Atmosphere Pounds.	Back Pressure Absolute Pounds.	Vacuum Inches.	Simple Engine Pounds Steam.	Compound Engine Pounds Steam.
-10	5	26.0	25	16
-9	6	23.4	25½	16½
-8	7	20.8	26	17
-7	8	18.2	26½	17½
-6	9	15.6	27	18
-5	10	13.0	27½	18½
-4	11	10.4	28	19
-3	12	7.8	28½	19½
-2	13	5.2	29	20
-1	14	2.6	29½	21½
0	15	0.0	30	22
1	16	..	30½	23½
2	17	..	31	23
3	18	..	31½	23½
4	19	..	32	24
5	20	..	32½	24½
6	21	..	33	25

For the purpose of obtaining coefficients so as to arrive at the increase or decrease of radiation required when the temperature of the surface is changed, the chart shown in Fig. 6 has been worked out. The chart is based on the assumption that for a mean temperature of 170 degrees Fahrenheit inside the radiator it will emit 170 British thermal units per square foot per hour when the temperature in the room is seventy degrees. The curves represent the following conditions: No. 1, direct radiation from three columns thirty-eight inches high, room at seventy degrees. No. 2, direct radiation three columns thirty-eight inches, room at fifty-seven degrees. No. 3, indirect radiation, air heated to 120 degrees. No. 4, indirect radiation, air heated to seventy degrees. No. 5, indirect radiation (forced draught by fan), air heated to 120 degrees. No. 6, indirect radiation (forced draught by fan), air heated to seventy degrees.

Taking curve No. 1, which applies to direct water radiation of three columns with a standard height of thirty-eight inches, maintaining an interior temperature of seventy degrees, the question would arise, how many heat units would this surface throw off at any other temperature? Assuming the question, what would be the radiation at 200 degrees, it is found that by taking the vertical column indicated at 200, and following it until it intersects curve No. 1, the coefficient would be 1.5. Multiplying this coefficient by 170, we determine that each square foot would then throw off 255 heat units per hour.

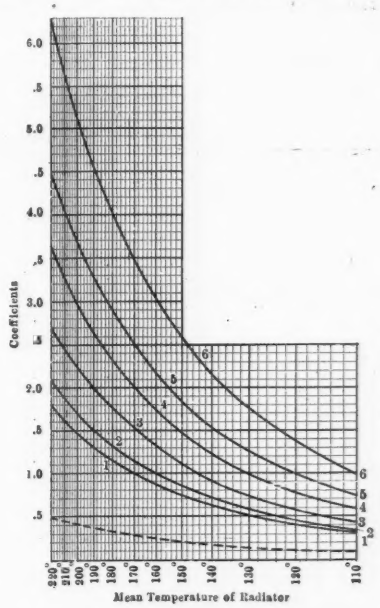


FIG. 6.—CALCULATING MEAN TEMPERATURE COEFFICIENTS.

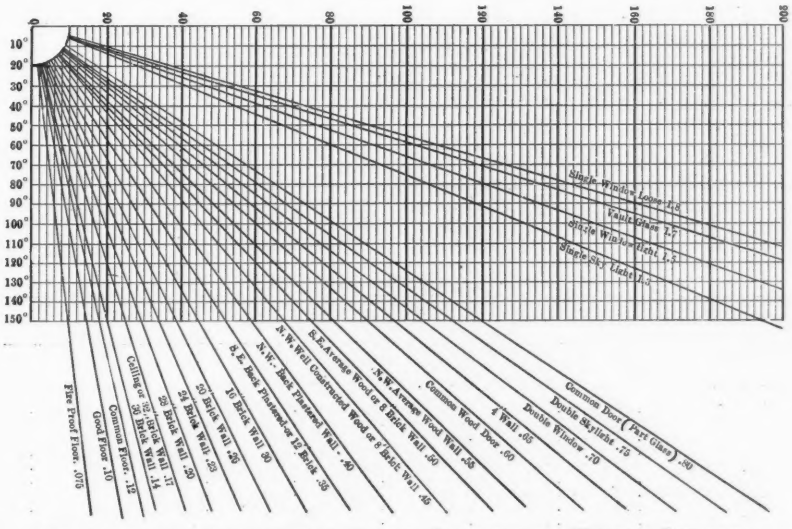

Single Window Inside Blind
Single Window 1.5
Single Sky Light 1.5
Fire Proof Floor .075
Good Floor .10
Common Floor .12
Ceiling or 20" Brick Wall .14
20 Brick Wall .17
24 Brick Wall .20
20 Brick Wall .25
16 Brick Wall .30
S. E. Brick Plastered or 12 Brick .35
N. W. Well Constructed Wall .40
S. E. Average Wood or 8 Brick Wall .50
N. W. Average Wood Wall .55
Common Wood Door .60
4 Wall .65
Double Window .70
Double Skylight .75
Common Door (Part Glass) .80

FIG. 7.—GRAPHIC DIAGRAM, CALCULATING CONSTANTS FOR EXPOSED SURFACES.

Fig. 7 represents a chart which is applied in the same manner. This gives coefficients for exposed surfaces, the chart

being worked out to apply to any type of construction that has been experimented with up to date.

Table VI is used for arriving at the radiating requirements for cubical contents. The table is based upon maintaining a temperature of seventy degrees in the room, with a complete change of air each hour. The usual coefficients are as follows:

Light glass (single)	0.6
Average well-constructed, back-plastered frame building	0.16
Cubical contents	0.0073

Table VI is based upon six pounds of water per foot radiation per hour, the water entering the radiator at a temperature of 212 degrees and leaving it at 175 degrees. The radiator is of the decorated type, emitting 225 British thermal units per square foot per hour at a room temperature of seventy degrees. The mean temperature of the radiator is 190 degrees at twenty degrees below zero. In using this table, consideration must be given to physical conditions. If the basement pipes are not covered or, when not otherwise heated, if the basement is not tight, from ten to twenty-five per cent must be added. In considering the ceiling, if the attic is not floored or otherwise protected, or if the rooms or halls open to the attic or other openings, from ten to fifty per cent must be added. When the building is exposed to severe winds, from ten per cent to twenty per cent must be added. For steam heating these figures should be multiplied by 0.6.

TABLE VI.—CENTRAL STATION COEFFICIENTS. "A."

Kind of Surface.	Temperature of Room.							
	55°	60°	65°	70°	75°	80°	85°	90°
Single Glass, Loose	.58	.64	.69	.73	.77	.81	.85	.90
" " Tight	.48	.53	.57	.60	.64	.68	.72	.75
Vault Light, Glass	.57	.63	.68	.72	.76	.80	.84	.89
Single Skylight	.42	.455	.485	.52	.55	.585	.62	.65
Double Skylight	.24	.26	.28	.30	.32	.34	.36	.38
Good Door, Half Glass	.26	.28	.30	.32	.34	.36	.38	.40
Double Glass, Storm Windows.	.225	.24	.26	.28	.295	.315	.33	.35
Average Frame, N & W.	.175	.19	.20	.22	.23	.24	255	.27
" " S. & E.	.16	.175	.185	.20	.21	.225	.24	.25
8-in. Brick Wall or Well, N. & W.	.16	.175	.185	.20	.21	.225	.24	.25
Constructed Frame, S. & E.	.155	.16	.17	.18	.19	20	.215	225
Back Plastered Frame, N. & W.	.13	.14	.15	.16	.17	.18	.19	.20
" " " S. & E.	.11	.12	.13	.14	.15	.155	.165	.175
12-in. Brick Wall, N. & W.	.11	.12	.13	.14	.15	.16	.17	.18
" " " S. & E.	.09	.10	.11	.12	.13	.14	.15	.16
16-in. " " N. & W.	.09	.10	.11	.12	.13	.14	.15	.16
" " " S. & E.	.07	.08	.09	.10	.11	12	.13	.14
Ordinary Floor or Ceiling	.04	.0425	.045	.048	.05	.053	.057	.06
Fireproof Floor or Ceiling	.02	.0225	.025	.0275	.03	.0325	.034	.035

Table VII gives the coefficients for various changes of air per hour. This table is based upon six pounds of water per foot of radiation per hour. The water enters the radiator at 212 degrees, leaving it at 170 degrees. The radiator is of the decorated type, emitting 225 British thermal units per square foot per hour at seventy degrees. The mean temperature of the radiator is 190 degrees at twenty degrees below zero. These figures, as in the previous case, must be multiplied by 0.6 for steam heating.

The inventor claims that with a plant of this kind a high degree of efficiency will be maintained, a flexible system will be found to exist at all times, and the consumers will be well satisfied. The successful operation of a plant of this kind depends not entirely on how efficient the plant is of itself, but depends a great deal on the carrying through of all details applying to the complete equipment. The building must have the same careful attention as to the amount of radiating surface and the position of the heating surface in order to make the entire equipment complete and in harmony from start to finish.

TABLE VII.—CENTRAL STATION COEFFICIENTS. "B."

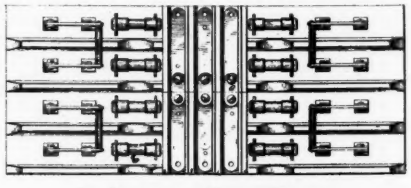
Changes of Air per Hour.	Temperature of Room.							
	55°	60°	65°	70°	75°	80°	85°	90°
½	.003	.0032	.0034	.0037	.0039	.0042	.0043	.0045
1	.006	.0064	.0068	.0073	.0077	.0083	.0086	.009
1½	.009	.0096	.0102	.011	.0115	.0125	.0129	.0135
2	.012	.0128	.0136	.0146	.0154	.0166	.0172	.018
2½	.015	.016	.0172	.0183	.0192	.0208	.0215	.0225
3	.018	.0192	.0206	.0219	.0228	.0249	.0258	.027
3½	.021	.0224	.0240	.0255	.0264	.0291	.030	.0315
4	.024	.0256	.0274	.0291	.03	.0332	.034	.036
4½	.027	.0288	.0306	.0333	.0351	.0378	.0387	.0405
5	.030	.0320	.0340	.0365	.0385	.0415	.0430	.045
5½	.033	.0352	.0374	.0407	.0429	.0462	.0473	.0495
6	.036	.0384	.0408	.0438	.0462	.0498	.0516	.054

The Boston Automobile Show.

The Boston (Mass.) automobile show opened at Mechanics' Hall, Saturday evening, March 10. The hall was thronged with an enthusiastic crowd of visitors and exhibitors, and it is announced that this was undoubtedly the most successful automobile exhibit ever held in that city. The exhibit included all the well-known types, and the display of novelties was particularly complete. The electric machines, while not displayed in great numbers, attracted an unusually intelligent degree of enquiry, and the consensus of opinion was to the effect that the popularity of this type of machine is constantly on the increase. The show continued for a week, closing on Saturday evening, March 17. Many of the motorists in attendance at the show were the guests of the Bay State Automobile Association at its club-house at Auburndale, on the outskirts of Boston.

A New Panel-Board.

Ernest R. Le Manquais, of New York, N. Y., has obtained a patent for a panel-board. The object of the invention is to provide an improved sectional panel-board, each section of which may be used independently if desired, and which sections may be combined in any number, so as to make up a panel-board of any desired size. A further object of the invention is to improve the devices for holding the fuses so that the fuses may be securely held with proper electrical contact and yet be removable at will without danger of injury to the operator. A further object of the invention is to construct the panel-board so as to minimize the danger of shocking persons operating or adjusting the board. The invention consists of a sectional panel-board



AN IMPROVED PANEL-BOARD.

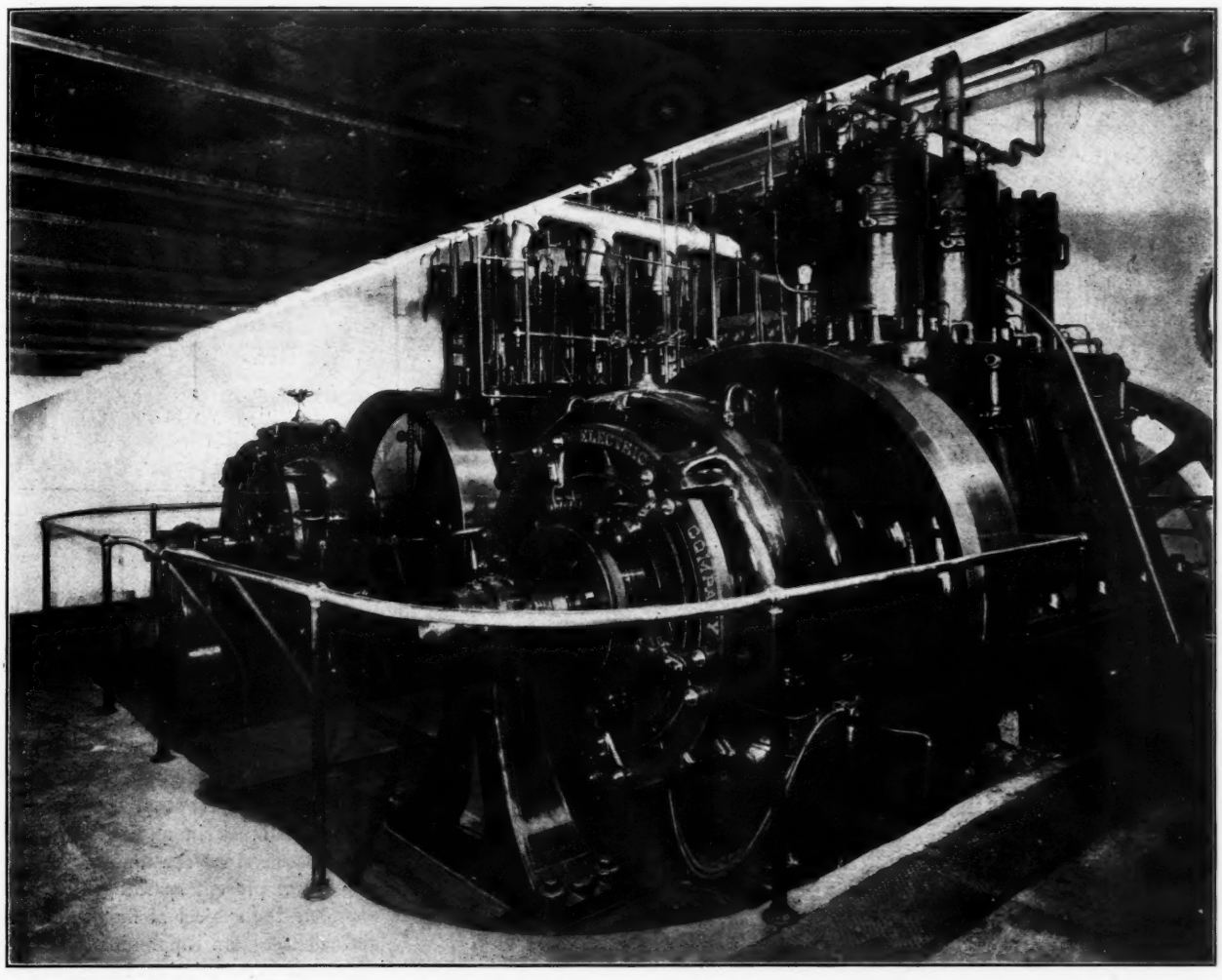
comprising a plurality of sections, independent bus-bars mounted respectively on the panel-board sections and lying contiguous when the sections are assembled, bridge-pieces extending between and attached to the contiguous ends of the bus-bar sections whereby to effect mechanical connections between the panel-board sections and electrical connections between the bus-bar sections, fuse holders and switches attached to the panel-boards at each side of the bus-bars and insulating ribs, a part of which extend transversely of the panel-board sections between and at the sides of the bus-bar sections, and others of which extend longitudinally of the panel-board sections between and at the sides of the fuse holders and switches.

The Diesel Engine Installation at the Traction Terminal Building, Indianapolis, Ind.

Within recent years considerable attention has been directed to the high economy of gas engines for the driving of electric generators. The very active competition now on between the manufacturers of reciprocating steam engines, steam turbines and gas engines has been provocative of extraordinary efforts in design and construction, resulting in many refinements in these types of machines. The Diesel engine plant installed for the Indianapolis Traction and Terminal Company at its office building in Indianapolis, Ind., by the American Diesel Engine Company is illustrative of the progress which this company has made in building direct-connected oil engines. The plant consists of two 175-brake-horse-power Diesel oil engines, each direct-connected to a 125-kilowatt Western Electric direct-current generator rated at 250 volts. The machines furnish current for the entire electric equipment installed at the office building, freight houses and train-shed. The load consists of incandescent lamps, of which there are about 3,000; fifteen direct-current enclosed arc lamps, three electric passenger elevators and about 150 horse-power in motors used for pumping ventilating fans, refrigerating apparatus and for sewer service. The lighting service is operated at 110 volts on the three-wire system, a compensator being installed. The service is continuous. A reference to the ammeter chart will show the character of the load, which runs to the usual peaks peculiar to office building operation.

The plant was installed in two units for the purpose of handling this variable load with high economy. The two engines are run in parallel when the load becomes too heavy for one unit, and under these conditions the operating fuel economy is stated to be practically constant through all stages of the load. Referring to the ammeter chart, it will be noted that during seventeen hours of the day's run the variation in load due to the elevators is about equal to 100 per cent increase, and this is so frequent that it is almost impossible to distinguish the movement of the instrument. It will be noted, on the other hand, that the voltage as shown by the voltmeter chart herewith reproduced is practically constant during the twenty-four hours, notwithstanding the continuous variation in load.

The figures on the extreme edge of the ammeter chart indicate the consumption



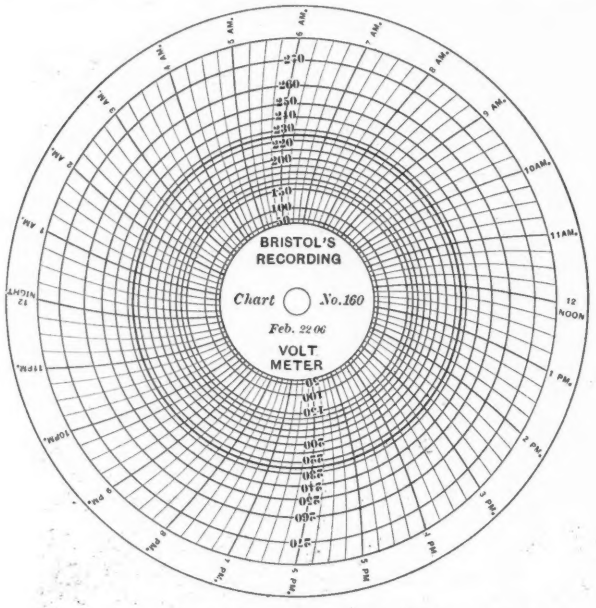
DIESEL OIL ENGINE PLANT, TRACTION TERMINAL BUILDING, INDIANAPOLIS, IND.

TRACTION TERMINAL BUILDING AND CAR SHED, INDIANAPOLIS, IND.

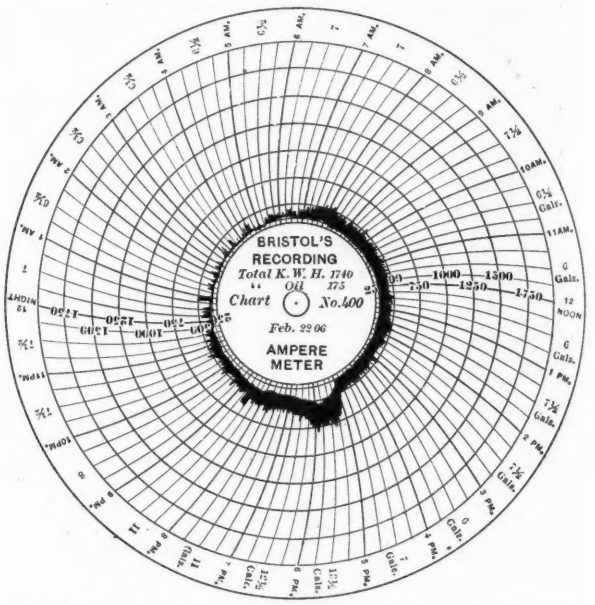
of fuel in gallons per hour. It will be noted that the fuel consumption approximates a direct proportion to the kilowatt output during the time indicated.

The guarantee made by the American Diesel Engine Company to the Traction Terminal Company, to cover the fuel consumption, was as follows: "This company guarantees that the consumption of fuel (either crude or fuel oil), under the purchaser's usual conditions of operation, will not exceed twelve and one-half gallons for each 100 kilowatt-hours as shown by wattmeter readings on the purchaser's switchboard, covering a period of one year from the date the plant is offered for purchaser's service, under his regular operating conditions and load."

The following memoranda taken from the records of the operating engineer show the consumption of fuel and the kilowatt-hours delivered daily during the months of January and February, and also show the average kilowatt output to be 74.3 kilowatts per hour, or about 30.54 of the rated kilowatt capacity of the plant installed. These data show that the company is not only fulfilling its guarantee, but operating twenty per cent below the guarantee on a variable and difficult load, as demonstrated by the ammeter chart.



VOLTMETER RECORD, TRACTION TERMINAL BUILDING PLANT, INDIANAPOLIS, IND.



AMPERE-METER RECORD, TRACTION TERMINAL BUILDING PLANT, INDIANAPOLIS, IND.

DAILY RECORD OF KILOWATT OUTPUT AND FUEL CONSUMPTION FOR JANUARY AND FEBRUARY, 1906.

	Kilowatt-Hours	Gals. of Oil
Jan.	1, 1880	192
"	2, 1860	188
"	3, 1900	196
"	4, 1870	191½
"	5, 1820	193
"	6, 1780	186½
"	7, 1910	198
"	8, 1890	193½
"	9, 1860	184½
"	10, 1880	191½
"	11, 1860	192½
"	12, 1640	182½
"	13, 1690	184
"	14, 1850	191½
"	15, 1980	197
"	16, 1650	182
"	17, 1820	189
"	18, 1690	183
"	19, 1750	187
"	20, 1800	191
"	21, 1870	196½
"	22, 1880	195
"	23, 1830	197½
"	24, 1750	189
"	25, 1760	196½
"	26, 1670	176½
"	27, 1680	184½
"	28, 1770	185½
"	29, 1820	188
"	30, 1860	192½
"	31, 1860	197
	56140	5892½

	Kilowatt-Hours	Gals. of Oil
Feb.	1, 1860	192½
"	2, 1860	197
"	3, 1780	191
"	4, 1650	173
"	5, 1560	161½
"	6, 1720	173
"	7, 1740	189
"	8, 1850	181
"	9, 1970	192½
"	10, 1670	178½
"	11, 1670	178
"	12, 1590	167
"	13, 1810	189½
"	14, 1810	189½
"	15, 1780	183
"	16, 1860	184½
"	17, 1910	192½
"	18, 1570	173
"	19, 1700	171½
"	20, 1800	183
"	21, 1750	185
"	22, 1740	185
"	23, 1770	188½
"	24, 1810	191
"	25, 1610	184
"	26, 1640	169
"	27, 1810	189
"	28, 1800	185
	49090	5117

Total kilowatt-hours for January and February	105,230	
Total oil used for January and February	11,009.5	gallons.
Average kilowatts per day	1,783	
Average oil per day	185.4	gallons.
Average oil per 100 kilowatt-hours	10.4	gallons.
Average oil per kilowatt-hour	.104	gallon.
Average cost per kilowatt-hour, @ 3 cents	$0.00312	
Rated kilowatt capacity of plant	240	kilowatts.
Average kilowatts per hour	74.3	kilowatts.
Average load-factor	30.54	per cent.

The Conditions for Sparking at the Break of an Inductive Circuit.

An attempt is made in an article by Mr. J. C. Hubbard in the *Physical Review* (Lancaster, Pa., March) to establish a relation existing between the rapidity with which the break in an inductive circuit takes place and the constants of the system which will prevent sparking. The author considers the subject at first theoretically and deduces an approximate formula, which shows the relations between the constants of the apparatus and the velocity of the break which will prevent a spark. The equation indicates that this velocity of break is roughly proportional to the frequency and to the excess of the maximum potential over the minimum spark potential. The matter was investigated experimentally by arranging a circuit in which a capacity and an inductance were connected in series with a small storage battery. In parallel with the capacity was placed an interrupter in series with a resistance for regulating the current through this circuit, and in parallel with this interrupter circuit was placed an electrometer connected idiostatically. The break was made by means of a drop chronograph arranged so that the velocity of separation would be equal to the velocity of the falling weight. Data obtained for this apparatus gave a parabolic curve concave

toward the axis of electrometer deflections and convex toward the current axis. However, when the adjustment was not exactly right, values were obtained lying between the curve and the current axis. When a reading in this region was secured, careful examination of the contact showed that slight sparks occurred. The following are the general conclusions of the investigation: the necessary velocity of break, as determined experimentally, is a linear function of the initial current. For a given current this velocity increases in value in a consistent manner with the approximate equation mentioned. The velocity diminishes according to the equation with a diminution of the inductance. The results enable a limit to be placed on the velocity of break necessary to prevent a spark at the break of an inductive circuit if the inductance capacity and initial current are known. The necessary velocity will be lessened by any condition which causes the absorption of energy from the primary, such as a closed secondary, hysteresis, heat losses, etc. The method of experimenting was found very satisfactory.

Two Important Tunnel Proposals.

Some of our more important railroads are considering the question of reducing the height of the summit elevations on the main line of their systems by the construction of lengthy tunnels. According to recent dispatches, the Pennsylvania Railroad Company is about to lower the summit of the Alleghany mountain division by driving a great tunnel, which will be either nine miles or eleven miles in length, according as one or other of two alternative surveys is adopted. On the eastern slope the road would enter the tunnel in the vicinity of the Horseshoe Curve; on the western slope the portal would be in the neighborhood of Crescent. At present, the enormously heavy traffic of this road has to be hauled over a summit which is 2,160 feet above mean sea level, and by the construction of the tunnel, this would be cut down probably to about 1,500 feet. The importance of the reduction is not shown by the mere statement of reduction of vertical height; for on the eastern slope the grade is particularly steep, and the portion of the summit line that would be eliminated has an average grade, we believe, of something like two per cent. Another road, which has an important tunnel under consideration, is the Lehigh Valley Railroad, which by a change in the location of its line, and the construction of seven miles of tunnel through the mountain range in which the Lehigh river has its source, will eliminate many miles of heavy grade and reduce its summit elevation by several hundred feet.—*Scientific American.*

LIGHT EMITTED BY NON-CONDUCTORS UNDER ELECTRICAL EXCITEMENT.

BY ALFRED WILLIAMS.

If a piece of crystalline quartz, spar or any transparent or translucent material possessing considerable dielectric capacity and crystalline or cleavable structure is interposed in an electrical circuit of high potential and frequency, a brilliant white light is emitted. The emission continues only while the current flows.

The phenomenon observed in this experiment naturally suggests a consideration of the structural qualities of the non-conductor on the result obtained. A solid piece of glass measuring three by two centimetres is now interposed in the circuit, and, as may be expected, no luminosity is observable. Replacing the solid piece by a large number of small glass cubes of varying sizes, the light is at once apparent, but much feebler than in the experiment with quartz, etc. The obvious inference is that the spaces separating the cubes, though imperceptible and immeasurable, are vast compared with those of natural crystallization; this is proved to be the case, as the application of perpendicular and horizontal pressure on the pile of cubes immediately increases the intensity of the light.

Assuming intimacy of adhesion, as shown in the last experiment, to be an important factor, it necessarily follows that artificially produced fractures should still further increase the luminosity. The solid piece of glass, previously used, is now heated and plunged suddenly into cold distilled water. On cooling and thoroughly drying the mass is found to be fractured throughout and instead of transparency possesses translucency. This is now placed in the circuit and lights up with a brilliancy rivaling that of the quartz.

These experiments were made by the writer two years ago and many others have been made from time to time in an endeavor to more closely understand the phenomenon. The emission of the light is not caused by heat, the temperature being entirely inadequate.

THEORETICAL CONSIDERATIONS.

The action may be expressed as follows: when electricity flows between the contact surfaces of two non-conductors of similar or dissimilar specific inductive capacities a condition of molecular excitement is set up which radiates light waves.

Capillary force furnishes a somewhat striking analogy in the well-known experiment with glass plates and a drop of water. If a small quantity of water be inserted between two glass plates slightly inclined to each other a force is set up sufficiently powerful to draw the plates together and frequently to bruise or break them. The mechanical force caused by the introduction of a drop of water is enormous and consequently the molecular agitation must be terrific.

In this case the flowing of the molecules of a liquid compound between plane surfaces separated by a comparatively great distance caused a display of molecular energy manifest by actual disruption of the plates. That the plates are separated by a distance sufficiently great to be easily visible should be borne in mind in reference to the fact that the interposed substance was, compared with electricity, bulky and coarse. Perhaps if electricity were as "coarse" as water the light would be emitted from plates as far apart as those in the capillary experiment, as we find that on diminishing the distance between the plates by pressing them close together electricity passing between causes a molecular excitement of the order necessary to the production of light.

Continuing the experiments on the above hypothesis, half a dozen thin and chemically clean microscope slides are firmly bound together and placed in the circuit. The discharge passes mainly between one pair of plates emitting a feeble white light. On increasing the potential until one of the plates fractures, the electricity at once concentrates its pathway down the fracture and throws out a light of very great brilliance and intensity.

A group of well formed, transparent quartz crystals is perhaps the most effective of any of the substances investigated, but probably is so mainly on account of the intimate adhesion of its naturally formed crystals.

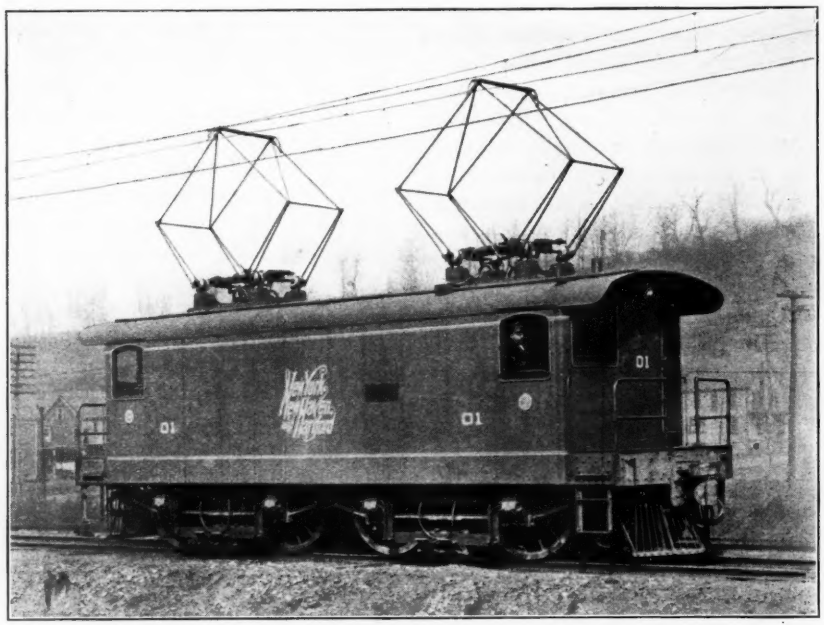
These experiments suggest an explanation of Piezo-electricity. Certain crystals, such as calc spar, possess the power of becoming electrified on pressure being applied to them by dry fingers. Presuming such pressure varies the degree of adhesion between the contact surfaces, as indeed it must, it follows that some corresponding change must take place in the relationship of position and affinity of the atoms and molecules of the crystal and the pervading ether, the resultant manifesting itself as electrification. If the pressure could be applied by the fingers with very great frequency it is conceivable that light would be emitted instead of something causing electrification. The passage of electricity between the contact surfaces possibly acts in this way, but more vigorously and frequently.

THE NEW YORK, NEW HAVEN & HARTFORD SINGLE-PHASE ELECTRIC RAILWAY EQUIPMENT.[1]

BY B. G. LAMME.

In the past few months two contracts have been taken by the Westinghouse Electric and Manufacturing Company for single-phase railway equipment involving locomotives of steam railway size. These are for the equipment of part of the New York, New Haven & Hartford Railway system and for the electrification of the St. Clair or Sarnia tunnel, under the Detroit river, on the Grand Trunk Railway. The former equipment will operate under high-speed passenger service conditions, while the latter approximates freight locomotive conditions.

In the case of the New Haven single-phase equipment, the problem is somewhat complicated by the fact that the locomotives must operate on direct current over the New York Central part of the New Haven system, and on alternating current on its own part of the line. However, this complication is not nearly as great as would appear at first thought, for the type of locomotive chosen is one which adapts itself well to both classes of service. However, there is necessarily some duplication of parts on the locomotive, such as the collecting devices, certain details of the controllers, wiring, etc. On the other hand, it is surprising how many parts are common to both classes of service. As the New Haven equipment in its alternating part embodies many features which have been carried out further than ever before, it may be of interest to describe it as a whole.

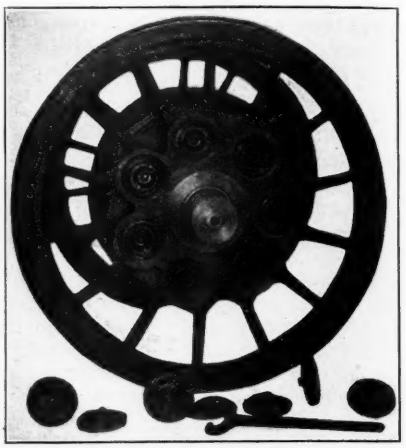


SINGLE-PHASE MOTOR CAR. NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

GENERATING PLANT.

The main power-house is at Riverside, about three miles from Stamford. The generators in this power-house are to be driven by steam turbines. The machines have single-phase ratings of 3,750 kilowatts, or about 5,500 kilowatts on three-phase, the armature winding being such that three-phase current can be obtained from the same machine. The generators have two poles and at 1,500 revolutions per minute give 3,000 alternations per minute or twenty-five cycles per second. A 5,500-kilowatt, three-phase, two-pole, 1,500-revolution-per-minute generator would have been considered an impossibility only a short time ago. The design of these generators was one of the difficult problems in this undertaking. The difficulty, however, was in designing the machines in the first place, and after a suitable construction was worked out, the manufacture of these machines appears to be comparatively easy. The machines have an ample margin, both electrically and mechanically, and they are particularly well adapted for handling inductive loads. As an illustration of unusual conditions met with in the design of such machines, I will mention that a single complete armature coil weighs about 600 pounds. However, as the machines have only two poles, the total number of armature coils is relatively small. As a machine in such service is liable to have rather short-circuits at times the armature end windings are extremely well braced.

As these machines are to feed directly into the trolley system, they are wound for the normal trolley tension of 11,000 volts, and in consequence one terminal of each machine is always grounded when in service, as in usual practice with direct-current railway generators. This point has been fully kept in mind in the design of these machines.



DRIVING-WHEEL WITH CAPS REMOVED TO SHOW POCKETS FOR DRIVING PINS OR QUILLS.

As the New Haven company contemplates operating certain existing direct-current systems from this power-house, it was decided to add an additional leg to the armature winding, so that three-phase currents could be obtained for feeding into rotary converter stations for furnishing direct current for some direct-current lines which, at the present time, can not be conveniently changed to straight alternating current. The New Haven company also has other fields for three-phase power which it proposes to take care of as soon as it is feasible to do so.

The steam turbines for driving these generators are of the well-known Westinghouse-Parsons type. On account of the large output and high speed an unusually good performance is indicated. The engines are designed for the single-phase rating of the generators, as it is anticipated that the heavy service and the load peaks will be due to the railway load.

OVERHEAD TROLLEY SYSTEM.

As 11,000 volts will be applied directly to an overhead trolley and as the trolley system will span from four to six tracks, it is evident that a very substantial overhead construction must be used. The construction of this overhead system is one of the most interesting features in this whole electrical system.

The trolley system is to be suspended

[1] Excerpt from a paper entitled "Alternating-Current Electric Systems for Heavy Railway Service," read before the New York Railroad Club, March 16.

from steel bridges which span from four to six tracks normally, and even a greater number at special points. These bridges are placed at intervals of about 300 feet and at points about two miles apart, heavier structures called anchor bridges, are placed.

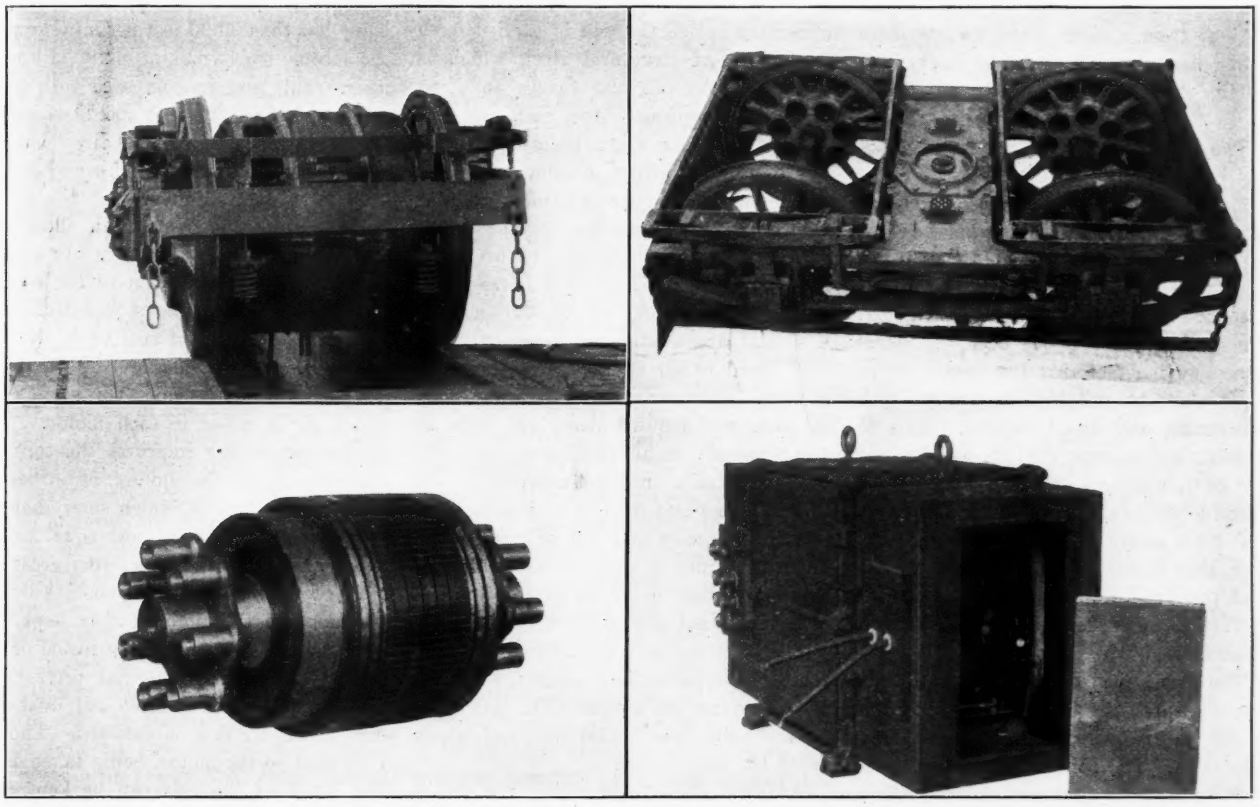
The steel cables which support the trolley wire proper are supported by massive insulators on the bridges. Two cables are used for each wire and form a double catenary suspension carrying the trolley wire by means of triangular supports. The double system of suspension gives increased stiffness to the trolley construction. The triangular supports are placed about ten feet apart. The steel cables have a total sag of about six feet, while the trolley wire itself is maintained in a practically horizontal position.

At points corresponding to the anchor bridges; that is, about two miles apart, each trolley wire is broken by section insulators and is connected to the other trolley wires and to two feeder wires through automatic circuit-breakers. Otherwise each trolley wire, with its cables and supports, is insulated from the adjacent wires. In this way each wire is sectioned and a short-circuit on any one section can cut it out without putting the neighboring wires out of service. The two feeder wires just mentioned are carried the whole length of the alternating system, and by means of these and the arrangement of automatic switches, any entire section of four or more trolleys could be cut out of service and the sections beyond can be kept in service.

The trolley wire has a nominal height of twenty-two feet above the track. This height will vary a few inches up or down with wide variations in temperature. The pantagraph type of trolley used on the locomotives has an effective range of about eight and one-half feet and therefore a very considerable variation in the height of trolley is permissible.

The overhead system is designed to be amply safe under abnormal conditions, such as high wind or heavy coating of ice. The stresses in the supporting cables with a load of ice one-half-inch thick or one-inch total, each side, on the cables, hangers, etc., will be about one-sixth of the ultimate. The stresses in the structure due to wind have been figured on a basis of sixteen and two-thirds pounds per square foot projected surface for the cables and twenty-five pounds per square foot normal surface for flat surfaces. This is on a basis of the cables being covered with ice as given above. Allowance is made for double these pressures in summer when there are higher wind velocities, but under this condition the cables will be of much smaller diameter in the absence of ice.

As 11,000 volts is used on the trolley system, no transforming stations are necessary on the part which is now to be installed. The high-voltage trolley system will extend about nineteen miles in one direction from the power-house and about three miles in the opposite direction to Stamford. This system could be extended in the latter direction approximately twenty miles further, if desired, without transforming substations. Therefore about forty miles of the trolley system can be supplied directly from the main power-house. With a locomotive load representing 4,000 kilowatts about nineteen miles from the power-house and a corresponding load fifteen miles away, or four miles from the power-house, the drop at the end of the line will be about thirteen per cent. This drop is on the basis of feeding into the load from one direction only. If there were a transforming substation about forty miles away from the power-house, feeding into the same trolley system, then the drop at a point



SINGLE-PHASE ELECTRIC LOCOMOTIVE, NEW YORK, NEW HAVEN & HARTFORD RAILROAD. FIG. 1.—ONE OF THE TRUCKS, SHOWING MOTORS IN PLACE. 2.—ONE OF THE TRUCKS. 3.—AN ARMATURE COMPLETE WITH QUILL. 4.—ONE OF THE TWO STEP-DOWN TRANSFORMERS.

twenty miles away would not be thirteen per cent, but would be considerably less, as power would be supplied from both directions. It is apparent, therefore, that with substations along the line feeding into a common trolley system, such substations could be possibly sixtv miles apart. For example, if a transforming substation were placed in New Haven about forty miles away from the power-house, the drop at the midway point between the substation and power-house would be equivalent to a load on the present system at ten to fifteen miles from the power-house. However, the above distances between substations are so great that it might prove inadvisable to feed more than one or two substations from a given plant, two or more power plants being installed on a very long system.

THE LOCOMOTIVE.

The frame, trucks and cab of this locomotive were built by the Baldwin Locomotive Company, on designs developed after many conferences between the New Haven Railway Company, the Baldwin Locomotive Company and the Westinghouse Electric and Manufacturing Company. The design adopted was partially determined by the fact that the motor equipment must be suitable for use on both alternating and direct current. This to a certain extent controlled the number and size of the motors and thus affected the construction of the trucks and other parts. The results have turned out so well, however, that there is every reason to believe that this type of locomotive will be used in future even where alternating current alone is used.

The mechanical construction of the locomotive presents many novel and interesting features which deserve special consideration. The running gear consists of two trucks, each mounted on four sixty-two-inch driving wheels. The length of wheel-base is eight feet. The side frames are of forged steel and to them are bolted and riveted the pressed steel bolster carrying the centre plate. The weight on the journal boxes is carried by semi-elliptic springs with auxiliary coiled springs under the ends of the equalizer bars, to assist in restoring equilibrium. The bolsters are thirty inches wide at the centre plate and are widened, where bolted to the side frames, to nearly double this amount, thus giving a very strong construction without excessive weight. The centre plate which transmits the tractive effort to the frame is eighteen inches in diameter and will be lubricated to permit a perfectly free motion in curving. The truck centres are fourteen feet six inches apart.

Owing to the fact that the entire space between the wheels is occupied by the motors, it was impossible to transmit the drawbar pull through the centre line of the locomotive in the usual way. Instead of this, strong plate girders heavily cross braced are carried outside of the wheels and the entire strain of the drawbar is carried to these through strong box girders having top and bottom plates forty-two inches wide. Directly underneath the girder at each end is a Westinghouse friction draft gear to which the drawbar is attached. The entire design lends itself to a very strong construction without great weight. The cab is built up of sheet steel on a framework of "Z" bars. The apparatus inside the cab is carried on a framework of structural steel, which is built into the cab and firmly anchored to floor and ceiling. Over each motor is a large trap-door which permits easy access to motor bearings, brushes, etc.

The motors are four in number, each of 250 horse-power nominal capacity, but with a continuous capacity of over 200 horse-power each, or over 800 horse-power total. The motors are of the gearless type and are wound for a normal full-load speed of about 225 revolutions per minute. They are connected permanently in pairs and require about 450 volts at the terminals on alternating current and 550 to 600 volts on direct current.

The frame and field of each motor are split horizontally and can be removed in halves in order to give access to the inside of the field or to the armature. The armature is not placed directly on a shaft, but is built up on a quill through which the car axle passes with about five-eighths inch clearance all around. On this quill, at each end, are placed bearings which carry the field frame.

At each end of the quill is a flange from which projects seven round pins, parallel to the shaft, into corresponding pockets in the hub of the wheel. Around each pin is placed a coiled spring wound with the turns progressively eccentric. These springs are contained between two steel bushings, the smaller of which slips over the pin, and the larger fits in the pocket in the wheel. These springs are amply strong to carry the entire weight of the motor, but are normally required to transmit only the torque of the motor and to keep the motor axis parallel to the axle. They allow a total vertical movement of about three-quarters of an inch. The end play of the motor, instead of coming directly on the wheels, is taken by strong coiled springs inside of the driving pins which press against covers in the outer ends of the spring pockets in the wheels. The torque on the motor frame is taken by heavy parallel rods which anchor the frame to the truck above and below the axle. These rods permit vertical or side motion of the motor, but prevent excessive bumping strains from coming on the motor driving springs. The entire weight of the motor is normally carried on springs supported from a steel frame surrounding the motor and resting on the journal boxes.

The motors are internally of the same general type which the Westinghouse company has been building for some time for interurban service. However, due to the relatively low speed of the motors, the maximum commutator speed is very low, being less than 3,000 feet per minute when the locomotive is making sixty miles per hour. This may be compared with 5,000 to 7,000 feet commutator speeds which are frequently attained in both direct current and alternating-current high-speed service with fairly large motors.

One interesting feature in these motors is the method of cooling. As a blower is used in the locomotive for cooling the lower transformers, it was decided to extend this method of cooling to the motors also. In the floor of the cab is an air conduit of considerable size, from which air is piped to each motor. This method of cooling improves the continuous capacity of the motors, as evidenced by the above figures, which show that the continuous rating is almost equal to the one-hour rating. A further very great advantage in this method of cooling lies in the fact that the motors can be kept very clean in this manner, as the inside of the motor is kept under partial pressure at all times, tending to keep out dust and dirt, as all air flow is outward. The air furnished to the motor, being taken from the inside of the cab, can be kept relatively clean and dry.

On the direct-current part of the line, current is taken from the third-rail system, except in the case of some short sections at cross-overs fed from an overhead trolley on direct current. The motors are controlled in the usual series parallel method in combination with resistance, as in ordinary direct-current practice.

On alternating current the motors are not operated in series parallel as on direct current, but are connected permanently in a given manner and the supply voltage is varied. This gives an equivalent of the series parallel, except that the number of efficient operating steps is much greater. On alternating-current operation no resistance is used in regular run-

ning, but a slight amount is used in passing from one working step to the next, this being in the nature of a preventive device to diminish the short-circuiting effect when passing from one transformer tap to another. There are six operative voltages, or running points, on the alternating current, corresponding to six taps on the lowering transformer, while there are a small number of intermediate steps, which are used only in passing from one working point to another. Experience has shown that the number of steps on alternating current required to give a smooth acceleration is considerably smaller than required on direct current. In consequence the controller is so arranged that on alternating current about half as many steps are used as on direct current. The tests have shown that the acceleration on both alternating current and direct current is very smooth.

There is one feature in the direct-current control which is not generally found at the present time on direct-current equipments, namely, shunting the field for higher speeds. On the series position on direct current the motors have an efficient running point. It is usual railway practice to pass from the series to multiple position by introduction of resistance, there being no intermediate efficient running speed. On the New Haven equipments, however, the type of motor used is one which permits an almost indefinite shunting of the field without affecting the commutation or operation otherwise, and advantage is taken of this to obtain several higher speeds by shunting the fields before passing into multiple. In this way several efficient running points are obtained between the series and multiple. The tests have shown that these motors will operate in a perfectly satisfactory manner on direct current with their fields shunted down to much less than half their normal strength.

When operated on direct current, as stated before, the current is fed directly to the motors. On alternating current, however, step-down transformers must be used, as the alternating-current trolley voltage is 11,000. The step-down transformers are two in number, one on each side of the cab, in order to balance the weight in the cab. It must be borne in mind that these transformers are the heaviest single pieces in the cab and there would be considerable difficulty in placing a single transformer to advantage. A further reason for two transformers is that an injury to one would not entirely disable the locomotive. The transformers are connected in parallel across the high voltage, but on the low-voltage side each transformer feeds one pair of motors, through a separate control unit. This means that the controller when operated on alternating current consists of two normally independent units.

The main controllers are of the well-known Westinghouse electropneumatic unit switch type. The design, however, differs somewhat from the straight direct-current type, due to the fact that switches, blow-outs, etc., must operate on both alternating and direct current as many parts of the controller are common to both. It may be mentioned also that the reversing switches are of the unit switch type.

The main controllers are operated from master controllers at each end of the cab. The controller system is arranged for multiple unit operation so that two or more locomotives may be coupled to the same load.

In addition to the controlling and transforming apparatus there is a number of auxiliary parts, such as two air compressors driven by motors which can be operated on either alternating current or direct current; two blowers driven by similar motors, for furnishing air to the transformer and motors, and to the direct-current rheostat. It may be mentioned that the air which passes through the transformers is also sent through the rheostats. When operating an alternating current the transformer is heating the air which passes through, and this air would not be very effective in cooling the rheostat. However, when running on direct current the transformer is idle, and the air passing through becomes effective in the rheostat.

In addition to the above auxiliary apparatus there are oil circuit-breakers for the high-tension alternating-current switches for throwing from alternating current to direct current, and many details which would be found in any electric locomotive. There is also a steam generator in the cab for the purpose of generating sufficient steam for heating the coaches in cold weather.

The locomotive is equipped with devices for collecting both alternating and direct current. For the latter there are eight collecting shoes, four on each side of the locomotive, arranged in pairs of two each. There are, of course, two pairs on each side, one at each end, for the purpose of bridging such gaps as are necessary in the third-rail system. There must be shoes on each side, as the locomotive must be able to make contact with the third rail when turned end about. These direct-current contact shoes must also be able to work on two forms of third rail, one in which the shoe runs under the rail and the other where the shoe runs on top of the rail. The locomotive is provided with a pantagraph low-tension overhead direct-current trolley to conform with certain New York Central requirements.

For collecting alternating current the locomotive is provided with two pantagraph type high-tension bow trolleys. Each trolley has a capacity to carry the total line current under average conditions, but two are provided to ensure reserve capacity.

Each of these locomotives is to be able to handle a 200-ton train in local service on a schedule of twenty-six miles per hour, with stops averaging about two miles apart. In order to make this average speed the maximum speed will be about forty-five miles per hour.

One locomotive will also be able to handle a 250-ton train on through service. For heavier trains than this it is intended to couple two locomotives together and operate them in multiple. This presents no difficulties, for, as stated before, the locomotives are fitted up for the multiple unit system of control.

Electrolytic Tin Refining.

Dr. H. Mennicke, in *Elekrochemische Zeitschrift,* December, 1905, shows that the electrolytic refining of "work-tin" with a tin fluosilicate solution would be practicable and profitable. Among the advantages are the preparation of chemically pure tin, which commands a high price and is especially suited for making tin salts, tin oxide, etc. His conclusions are as follows:

1. The preparation of the tin electrolyte is much more difficult than that of the corresponding lead solution.

2. The removal of hydrofluoric acid from the solution is not necessary.

3. The regeneration and purification of electrolyte is more difficult than in the Betts lead process.

4. The current yield is lower than in Betts process.

5. Solid refined tin can be obtained under certain conditions.

6. The electrolytic refining of tin is economical in the absence of much lead. The removal of copper, bismuth and antimony is easy.

7. The extraction of tin from lead-tin alloys is possible, but not economical.

8. A combination of electrochemical and chemical processes for refined lead alloys is not economical.—*Engineering and Mining Journal.*

Possible Fields for Electric Service.

The accompanying table has been prepared by the Cooperative Electrical Development Association, Cleveland, Ohio, showing the ratio of the population in the whole state to that portion of the population where electric service is available:

(a) The number of cities and towns.
(b) Population of cities and towns where electric service is available.
(c) Number of light, heat and power plants.
(d) Population census of 1900.
(e) Per cent of total population where electric service is available.

STATES.	A	B	C	D	E
Alabama	54	246,769	45	1,828,697	13.49
Arizona	16	41,946	14	122,931	34.12
Arkansas	62	173,654	63	1,311,564	13.24
California	186	968,456	175	1,485,053	65.21
Colorado	69	309,447	79	539,700	57.34
Connecticut	84	667,568	50	908,355	73.49
Delaware	11	97,292	9	184,735	52.67
District of Columbia	1	278,718	1	278,718	100.00
Florida	37	132,329	36	528,542	25.04
Georgia	81	406,352	78	2,216,331	18.33
Idaho	37	42,203	34	161,722	26.10
Illinois	394	2,968,077	397	4,821,550	61.56
Indiana	177	999,724	190	2,516,462	39.73
Indian Territory	27	42,756	27	391,960	10.91
Iowa	201	749,486	202	2,231,853	33.58
Kansas	83	404,252	87	1,470,495	27.49
Kentucky	78	497,307	83	2,147,174	23.16
Louisiana	37	410,557	38	1,381,625	29.71
Maine	87	329,050	75	694,466	47.38
Maryland	32	607,787	36	1,190,050	51.07
Massachusetts	167	2,410,769	126	2,805,346	85.93
Michigan	249	1,167,339	240	2,420,982	48.22
Minnesota	159	745,890	171	1,751,394	42.59
Mississippi	68	175,674	66	1,551,270	11.32
Missouri	145	703,767	154	3,106,665	22.65
Montana	24	97,937	29	243,329	40.24
Nebraska	73	288,716	74	1,068,539	27.02
Nevada	10	17,372	7	42,335	41.03
New Hampshire	68	270,992	55	411,588	65.84
New Jersey	154	1,432,524	97	1,883,669	76.05
New Mexico	13	34,251	13	195,310	17.54
New York	336	5,550,859	295	7,268,012	76.37
North Carolina	62	231,930	59	1,893,810	12.25
North Dakota	25	49,086	26	319,146	15.38
Ohio	268	2,199,008	274	4,157,545	52.89
Oklahoma	22	74,655	21	398,245	18.75
Oregon	56	168,995	45	413,536	40.86
Pennsylvania	396	3,705,916	317	6,302,115	58.80
Rhode Island	20	331,663	13	428,556	77.39
South Carolina	48	203,700	46	1,340,316	15.19
South Dakota	35	64,857	35	401,570	16.15
Tennessee	73	385,504	67	2,020,616	19.07
Texas	151	662,330	162	3,048,710	21.72
Utah	23	102,524	20	276,749	37.04
Vermont	61	151,536	48	343,641	44.10
Virginia	55	380,714	53	1,854,184	20.53
Washington	61	269,216	58	518,103	51.96
West Virginia	53	171,598	52	958,800	17.90
Wisconsin	181	947,742	178	2,069,042	45.80
Wyoming	18	40,296	18	92,531	43.55
Total	4,828	33,411,090	4,538	75,997,687	43.96

National-Interstate Telephone Association.

The annual convention of the National-Interstate Telephone Association will be held in Chicago, Ill., at the Auditorium Hotel, June 26, 27 and 28. The change of place to Chicago from St. Louis, Mo., as previously announced, was authorized by the executive committee at the request of many prominent telephone men, in view of the fact that the Kinloch Telephone Company, of St. Louis, will be cutting over to its new switchboard at the time of the convention. The request has been made that the association meet in St. Louis next year, when it will be entertained in a more desirable manner.

A New Carbide Furnace.[1]

The manufacture of calcium carbide being a simple chemical process and not an electrolytical one, it is remarkable that the results obtained in practice are far below what are theoretically possible. The precise temperature required for the reaction $CaO + C_3 = CaC_2 + CO$ is still a matter of doubt. Assuming it to be 3,300 degrees centigrade, the theoretical yield would be 35.75 hundredweight of 100 per cent carbide per electrical horse-power per year, working continuously.

This is obtained as follows:

	Calories.
To reduce 56 grammes CaO requires..	145
To raise 56 grammes and 36 grammes C. to 3,300° C. requires.....	79
	224
Deduct calories disengaged by the formation of CO.....	29
Calories required for the production of 64 grammes CaC_2 = ...	195

It is probable that energy is given out by the formation of CaC_2, but as the amount of this is doubtful it is left out of the calculation.

If 195 calories produce sixty-four grammes Ca_2C, then 5,646,205 calories (one-horse-power-year) will produce 35.75 hundredweight of 100 per cent quality and proportionately more of the standard commercial quality. The actual results obtained in most factories fall far short of this, being about twenty-five hundredweight per horse-power-year. In the above calculation the energy is estimated at the electrode terminals in the furnace, therefore any leakage that occurs must be looked for within the furnace. Making due allowance for loss of heat by diffusion, which can be reduced to a small amount, the leakage must therefore occur between the electrodes, and being thus located the cause of the loss becomes explicable. It is the general practice in dealing with chemical processes, no matter at what temperature, to ascertain the most suitable rate for feeding the raw material into the vessel, and also the minimum time necessary to complete the reaction and remove the finished product. It may safely be stated that this principle has not been applied to the manufacture of carbide of calcium, and the chief cause of the great difference between the theoretical and practical yield is traceable to neglect of this principle. The "tapping" or running-off furnace goes some way toward fulfilling the above conditions, but experience has proved that this design still leaves much to be desired.

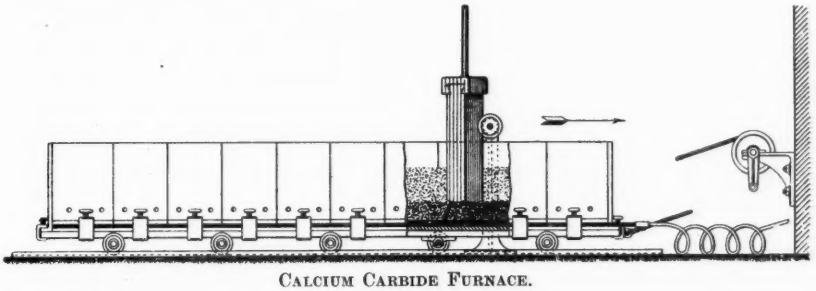
If a suitable mixture of ground carbon and lime can be delivered with precise regularity to the space between the electrodes, and with equal regularity be removed immediately it is transformed into carbide; and if, at the same time, provision is made for the escape of the carbon monoxide gas; and if the electrodes are protected from the air, then these conditions should produce a yield that approaches what is theoretically possible. These conditions appear to have been sought for in a modification of Borcher's English patent 6,061 of 1899, which describes a cake of raw material being fed into the space between two stationary vertical electrodes. In this apparently simple arrangement there are drawbacks, such as the consumption of the electrodes owing to the presence of air, the fusing and breaking up of the cake before it reaches the position of critical temperature, and the disturbance caused by the violent evolution of CO.

This is only one of the numerous devices

[1] From the *Chemical Trade Journal*, London.

which have for their object the principle previously described. The furnace shown in the adjoining sketch combines all the conditions required for obtaining the highest possible yield. It has recently been worked on a large scale, and has produced a yield of carbide equivalent to 30.5 hundredweight per electrical horse-power per year.

The leading features of the furnace are the production of a continuous horizontal ingot of carbide instead of a vertical one, electrodes protected from the air, regular feed of the raw material, automatic removal of the finished product without waste of energy in reheating, and insignificant cost of construction and upkeep. It can be repaired even while working. It consists of a long shallow cast-iron trough. The side walls are formed of separate vertical cast-iron plates with flanges at the bottom, by means of which they are clamped to the bottom plate or floor of the furnace by G clamps. Any of the side plates can be thus quickly replaced when burnt. Holes are provided in the side plates for the escape of the carbon monoxide gas in the well-known manner. The electric current is conducted to the lower electrode by means of flat copper tapes which run along each side of the furnace, and are gripped by clamps between the flanges of the side plates and the floor plates. The furnace is mounted on a trolley running in channel-iron rails. The upper vertical electrode is maintained in a vertical stationary position by means of the arm and insulated roller pressing against it.



CALCIUM CARBIDE FURNACE.

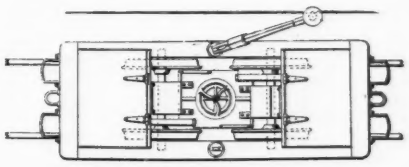
The operation is started at one end of the furnace exactly in the same way as in the usual vertical type of ingot furnace. When the ingot has reached a height of a few inches, the floor of the furnace is covered with a layer of the raw material, which is "battered" down into a hard cake, and the furnace is then filled up nearly to the top with more loosely packed material. The furnace is slowly hauled by means of the winch in a horizontal direction. The upper electrode, which is square, presents one of its corners toward the charge being drawn against it, thus enabling it to plough its way through. During the movement the loosely packed material is manipulated so as to keep the end of the vertical electrode covered and protected from the air. The carbon monoxide gas is allowed to blow through the holes in the side plates. When the furnace has traveled its full length the starting end has been already discharged and made ready for a new cake to be formed. The vertical electrode is then raised, the furnace is hauled back to its original position and the operation can thus be carried on continuously. The floor of the furnace is covered with a layer of roughly granulated coke run in with pitch to protect the cast iron. It will be seen that the lower electrode consists of that part of the furnace floor that is immediately beneath the upper electrode during any part of the operation.

A large number of small water powers in Great Britain are to-day standing idle which could be profitably employed in manufacturing calcium carbide. In most cases these powers, varying from 200 to 400 horse-power, are already "harnessed" to old-fashioned wheels, and very little capital would be required to substitute modern turbines for the water-wheels and thus obtain the maximum power. By the adoption of the furnace described, carbide of calcium can be produced at a cost of $35 per ton from a 200-horse-power plant. This estimate does not, of course, cover interest on the original capital outlay for head and tail-race, etc. If this is "written off," the above estimate includes interest on new capital and all other charges.

The Michigan Central (the Niagara falls route) has published a handsome calendar beginning with March and running until February of 1907. In addition to the monthly calendar each page contains views along the route of the Michigan Central and illustrations of the various limited trains of this service.

Trolley-Supporting Device.

An improved trolley-supporting device has been invented by Alexander Palmros, Columbus, Ohio, and he has assigned it to Joseph A. Jeffrey, of the same place. (813,515, February 27.) One of the objects of the invention is to provide for the current-transmitting device of such a car, a support and controlling mechanism by which the wheel of the current-transmitting device will be pressed laterally against the side of the conducting-wire, so that the transmitter shall be independent of the vertical dimensions of the entry, but shall rather depend upon the space crosswise or lateral of the latter, which is generally ample. The conductor-wire in such places as mine-entries can be arranged in a vertical plane, which is at all points substantially parallel to that of the track—that is to say, so that there shall be but little variation horizontally from the vertical planes of the track—and can therefore employ positively acting stops, which will permit the trolley wheel to vary its position horizontally within sufficient limits, but prevent it or its pole from striking the vertical wall or any objects along the side of the passageway or entry, the present construction in this latter respect being superior to those employing upward pressed or "underrunning" trolleys, for which there must be provided a wide range of vertical movement and which are therefore apt to be forced upwardly violently against the roof of the mine in case the wheel escapes from the wire. The invention consists in the combination of an electric car or locomotive, a trolley adapted to bear laterally against a conductor, a horizontally rotatable carrier for the trolley adapted to be turned to reverse the trolley from a forward position to a rearward position, a coiled spring arranged within a chamber in the car, a holder or support on the car for the trolley carrier, a shaft or rod supported in the holder and extending into the spring-chamber, means for connecting the shaft or rod with the trolley carrier, and means connecting the shaft or rod with the spring whereby the trolley will be held against the conductor with a uniform pressure whether the latter is in its forward position or in its rearward position.



TROLLEY-SUPPORTING DEVICE.

Reviews of Current Engineering and Scientific Literature.

Method of Producing Waves of Frequency Intermediate between Heat Waves and Hertzian Waves.

There is a considerable gap of unexplored wave-lengths intermediate between those of Hertzian waves and what is commonly known as heat. The shortest Hertzian waves which have heretofore been produced are of the order of one millimetre in length. In this communication Professor Reginald A. Fessenden describes a method of obtaining waves of intermediate length. The method was discovered by the author some years ago, but he has been unable to carry on any work with it. If two copper rods are placed against the plane surfaces of two plano convex lenses having the convex surface directed toward each other and separated by a very short air-gap, and are charged from a source of high potential, discharges will take place across the gap between the lenses, and these discharges will have short wave-lengths. If the lenses be replaced by metallic bodies the capacity of the system will be considerably increased and the wave-lengths considerably lengthened. But with glass lenses, as described, the wave-lengths of but a few ten-thousandths of an inch are obtained, and there appears to be no necessary limit to the frequency. Inert gases of the helium type seem to give the best results, but good results are obtained by using quartz lenses in air. Quartz is used because it does not seem to become conducting when heated by the passage of the discharge, as does gas. For this reason the wave-length remains more constant.—*Abstracted from Nature (London), March* 1.

The Operation of Circuit-Breakers and Fuses.

An experimental study of the operation of circuit-breakers and fuses has been made by Messrs. E. W. Marchant and F. A. Lawson. A circuit-breaker of the inverse time element type was connected in series with a number of fuses. The breaker was adjusted until it opened at the current required to blow the fuses, and then by means of a switch it was thrown in series with the fuses. It was found that with a normal fusing current of ten amperes a current of twenty amperes was required to fuse the wires and open the circuit-breaker at the same time. With a normal fusing current of twenty-two and one-half amperes the current required to open the breaker and fuse the wires simultaneously was forty amperes. Intermediate points lie upon a line connecting these two. A series of experiments was made with tin fuse wires to get the necessary data for showing the relationship between current through the magnetic circuit-breaker and fusing current of the wire in series that will just not fuse for a given setting of the magnetic cutout. This curve is rather peculiar and may be called the characteristic fusing current curve of the circuit-breaker. The area of it may be divided into two parts: one in which the breaker operates and the other in which the fuse melts. With currents below a certain value the fuse melts and the circuit-breaker does not open. With currents above a certain value both the breaker and the fuse open. At intermediate values the breaker alone opens. These values were determined for different normal fusing currents of the wire. It was found that below a certain point the wire always melts. An investigation of various kinds of metals as fuse wires pointed to the desirability of using fuses with high melting points, since such fuses act more quickly. It is possible that the use of such metals might obviate the necessity of a time-limit circuit-breaker.—*Abstracted from the Electrician (London), March* 2.

Applications of Single-Phase, Alternating-Current Motors to Hoisting.

The difficulty of utilizing single-phase, alternating-current motors for hoisting purposes lies in the fact that they are not self-starting, or, if made self-starting, they have but small starting torque. In this article M. Emile Dubois discusses the various methods of utilizing such motors and describes an interesting automatic coupling of the hydraulic type, developed by the Schuckert company. This coupling consists of a flange attached to the motor axle. This flange has cut in its side two annular chambers, communication between which is established through a small opening regulated by an adjustable screw. The inner chamber is filled with glycerine, and both the inner and outer chambers are covered by a flat leather diaphragm. This diaphragm, where it covers the outer chamber, presses against a flange which is normally held in by springs and which turns with the flange on the motor axle. The back of the former flange carries a leather disc, which, when slightly shifted axially, is brought in contact with a flange attached to the pulley from which the drive is taken. When the motor is standing still the pressure of the springs on the second flange forces the glycerine through a simple valve into the inner chamber. This motion of the second flange releases the flange on the pulley shaft so that it runs idle. When the motor is started the pulley does not turn until the second flange is moved sufficiently to bring the leather disc in contact with it. This takes some time and is brought about by centrifugal action, forcing the glycerine from the inner chamber into the outer one and thus forcing out the second flange. The rate at which this is brought about is controlled by means of the regulating screw mentioned above. When the motor is disconnected from the circuit the coupling is instantly released.—*Translated and abstracted from L'Industrie Électrique (Paris), February* 25.

A Dry Process of Generating Acetylene.

The usual method of generating acetylene and calcium carbide is to treat the material with water. The gas may, however, be obtained if the carbide be brought into intimate contact with crystallized sodium carbonate, usually known as washing soda. The action in this case is to set free acetylene and to form water, caustic soda, lime and chalk. This reaction is made use of in the Atkins dry process for generating acetylene gas. The generator consists of a drum divided transversely into three chambers. The drum, as a whole, revolves on a horizontal axis. Into one end chamber the carbide is introduced. The second or central chamber contains the soda crystals. The third chamber is filled with coke and serves for filtering the gas and holding back the dust. This generator is revolved slowly about its axis. Motion in one direction causes a small part of the carbide to enter the second chamber, where it comes in contact with the soda. If the drum be turned in the opposite direction the carbide does not pass out of its chamber, but that portion which has entered the second chamber is mixed intimately with the soda crystals by means of a stirrer. Acetylene gas is then generated, passes through the filtering chamber out through the hollow axle of the drum, then percolates through oil and is carried to the holder. It is said that by revolving this generator for about twenty to twenty-five minutes enough gas

can be generated to last a residence for twenty-four hours. The generator is fitted with a safety valve to protect it against excessive pressure, though the pressure generated at any time should be slight. The mixing chamber has a large cleaning door, through which the waste products are taken out. These are in the form of a dry powder and are removed without difficulty. Such a generator is six feet, six inches high, and occupies a space twelve feet by six feet. This includes the holder also, which has a capacity of about 250 cubic feet, sufficient for 120 burners.—*Abstracted from Engineering (London), March 2.*

Speed Regulation of Single-Phase Induction Motors.

In this section of a study entitled "A Contribution to the Theory of the Single-Phase Induction Motor," Mr. V. A. Fynn outlines a number of methods which can be used for varying the speed of single-phase induction motors. The author first divides the single-phase induction motor into four classes. The first is a single-phase, alternating-current motor with shunt characteristic, where the working voltage impressed on the armature axis is conveyed by induction with the help of a transformer field and where the electromotive force responsible for the motor field is generated with the help of the transformer field in the motor itself, the latter acting when revolving also as a phase converter. The second class differs from the first in that the motor field is generated by a winding disposed on the stator, the electromotive force responsible for the motor field being generated in a phase converter independent of the motor. In the third class the working voltage impressed on the rotor is conveyed by conduction, the self-induction of the rotor being neutralized. The motor field is generated by a winding disposed on the stator or rotor, as the case may be, the electromotive force responsible for the motor field being generated in a phase converter independent of the motor. In the fourth class the electromotive force responsible for the motor field may be generated wholly in the motor itself, or with the help of a transformer. The motor acts as a phase converter when revolving. The speed of motors of the first class can be regulated by including in the rotor circuit along the motor field an electromotive force in quadrature with the impressed electromotive force, and by varying the magnitude and direction of the former, the regulating electromotive force being derived from a phase transformer. The motor field may be composed of interconnected windings partly disposed on the rotor and partly on the stator. By varying the magnitude or direction of the two component fields, the motor field may be varied. By varying the magnitude of the transformer field and thus varying the motor field while keeping a constant terminal electromotive force, the speed may be varied. There are a number of other ways by which motors of this class may be regulated. Motors of the second class may be regulated by varying the transformer field, by varying the exciting electromotive force, by introducing an electromotive force in the rotor circuit in phase with that responsible for the transformer field. Motors of the third class may be varied in speed by varying the electromotive force impressed on the rotor, by varying the exciting electromotive force, or by a combination of the two. Motors of the fourth class may be regulated as to speed by varying the electromotive force impressed on the rotor or by varying the electromotive force impressed on the rotor and keeping the motor field constant by varying the transformer field; by varying the electromotive force impressed on the rotor and keeping the motor field constant by including in the rotor along the motor field an electromotive force in quadrature with that impressed on the rotor. There are several other ways of varying the speed of motors of the fourth class.—*Abstracted from the Electrical Review (London), March 2.*

The Use of the Bolometer as a Detector of Electric Waves.

Experiments have been carried out by Lieutenant C. Tissot with a bolometer as an apparatus for measuring the intensity of electrical oscillations. The results, in the main, confirm those obtained previously by Duddell and Taylor. The Langley bolometer depends for its action upon the increase in resistance of a small metal wire inserted in one arm of a Wheatstone bridge. For the purposes of these experiments it is necessary to protect the bolometer against all external sources of heat and to allow it to be affected only by the currents due to the oscillations to be measured. To accomplish this the arms of the bolometer were straight and short—only about one and one-half centimetres in length. The wire was very fine platinum, and the two arms of the bolometer were brought near together within the same enclosure. This was a double case of brass, silver plated, a thin air space being left between the two cases. Another instrument of the same class was insulated by means of a Dewar vacuum vessel. The two arms of the bolometer thus formed were inserted one in each arm of a Wheatstone bridge, the adjustment of which was obtained by means of a thick slide wire. That arm of the bolometer to be affected by the electrical oscillations was connected in series between the receiving antenna and the ground. In order to secure a proper zero setting, a supplementary adjustable resistance was inserted here and the instrument set so that when the current through this arm of the bolometer was changed in direction, but had the same value, the galvanometer gave the same deflection. The instrument was calibrated by means of small direct currents. The sensibility of this arrangement depends upon the sensibility of the galvanometer. Where extreme sensitiveness was required a moving needle galvanometer of the Thomson type, having a resistance equal to that of each arm of the bridge, was chosen. A deflection of ten millimetres with the scale at a distance of one meter was obtained with an effective current of 100 micro-amperes. It was found that with a given length of transmitting aerial there is a certain length of receiving aerial which gives the maximum deflection. When the aerials have the same form, resonance occurs always when the lengths are equal, whatever may be the general curvature of inclination of the aerials. It was found that there is a best value for the resistance in series with the receiving aerial. This in Lieutenant Tissot's experiments was between fifty and sixty ohms. The experiments were carried out over distances of from one to nine kilometres, and it was found that the effective value of the current in the receiving aerial is inversely proportional to the distance. The energy received, which is represented by the product of the resistance into the square of the current, therefore varies inversely as the square of the distance. A later experiment conducted over a distance of forty kilometres confirmed the first observations. The effect of various methods of earthing was studied and it was found that the earth secured on shipboard by connecting to the hull is much better than that obtained on land by means of plates buried in the ground. The experiments indicated also that if the number of interruptions is made to vary from N to N′ per second, the effective value of the current received by the aerial varies in the ratio of the square root of N to the square root of N′—a result which agrees with the work of Duddell and Taylor. Lieutenant Tissot gives some interesting values for the energy brought into play for various distances of transmission. With a current of 2.8 effective amperes in the transmitting wire and twenty-six interruptions per second, the current in a receiving wire 1.15 kilometres distant was 8,290 micro-amperes. With an aerial eight kilometres distant the current was 1,180 micro-amperes, and when the aerial was removed to forty kilometres the current was 235 micro-amperes. The product of distance into current in these cases gives a constant value.—*Abstracted from the Electrical Engineer (London), March 2.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

Under the title "The Function of Advertising in the Gas Business," Mr. Fenton P. Kelsey, advertising manager of the Milwaukee (Wis.) Gas Light Company, read a paper before the fifth annual meeting of the Wisconsin Gas Association, held at the Hotel Pfister, Milwaukee, February 14 and 15. The advertising of gas has been attended with so much success and Mr. Kelsey's ideas are so applicable to the advertising of electric light that the following extracts may be found of interest:

An advertisement, of whatever kind, should do four things: first, attract attention; second, arouse interest; third, create desire; fourth, bring about resolve to buy. This is true of the article which, once sold, the seller has nothing more to do, save to wish to repeat the sale of the identical article. It is true, so far as it goes, with writing an advertisement for gas—only the organization above referred to permits of the effect, whatever it may be, being followed up more completely.

Suppose the prospect has a mind which isn't logical enough to follow your advertisement through the "resolve to buy" stage, or suppose your advertisement isn't sufficiently logical or strong enough to bring him there. Suppose you have only attracted attention or aroused interest. Your solicitor comes along. He already has an opening. He is more liable to get a hearing. He is still more liable to, if you have so shaped your advertisement as to make that opening for him.

We have, then, exploited our product to the extent, at least, of making an opening for the solicitor.

Direct solicitation, everything else being equal, is of course the safest way to try to land business. The general manager of a company could, if he wished, stop every merchant he meets on the street and try to interest him in the use of gas arcs. But he is paid to attend to matters of more vital importance to the company.

So the solicitation is delegated to other men. As the number of people increase whom the man who does the soliciting wishes to see, he uses the telephone. By and by he gets other men to help him. The number of prospects increase and it becomes impossible for him, or his representatives, to appear before each in person as often as is desirable. So he sends each a letter, telling them his message as plainly and forcibly as possible. When the people he wants to reach get so many of this same sort of message that they are liable to pay little attention to his, he takes advantage of the human characteristics of curiosity, love of color, etc., and sends them cards with which he hopes to attract attention, then arouse interest.

The number of people he wishes to reach grows and he takes advantage of the organization of the modern newspaper which reduces to the minimum the expense of preparing his message and getting it into the hands of the people.

Again, he takes advantage of the fact that people do not stay at home all the time. They go to business and pleasure on the streets and by means of street cars. He sticks his message in big type before them on billboards and street-car cards.

You see that all these have a logical place in getting the attention of the mind.

The question which each of you asks yourself and would ask the man who has had anything to do with advertising: "which of these media is best?"

There is no denying that if you get it in such form and place that it will be read, newspaper advertising reaches more people more cheaply than any other means. For this reason it probably offers the best means for valuing the worth of other forms of advertising.

Now a little as to our experience in the use of newspaper space. The unusual always attracts your eye; so does the artistic. In the average newspaper nearly all the advertisements are set up from newspaper type. For this reason a design embracing lettering which will be entirely different from any found in the body of the paper is bound to catch the eye. Let this design have plenty of white and black effect and it is going to stand out still more. Let it embrace an illustration of the object you are pushing, or at least let it typify it so strongly that the eye of the reader, as it travels hastily across the page, will fall upon it.

A certain high-minded seriousness in your tone is going to make the impression you want to make on the mind of the man you want to reach and the depth of its effect will be in exact ratio of the earnestness and straightforwardness of your presentation.

It is for this reason, I believe, that some of the best arguments on paper that you and I have seen have been prepared by hard-headed business men, directly in charge of their own business, who don't know a thing about what some people call the "science of advertising," who perhaps can't even spell correctly, but who are thoroughly acquainted with every phase of their own business and, what is more important, the ones most vitally interested in the returns from money spent.

This does not mean that serious copy can not be full of life. It does not mean that it can not be short and crisp, that you can not talk in a humorous vein, if this humorous vein is used immediately to press your point and if the moral is not a far cry from the humor. Remember, however, that it is very costly to buy space, or good-looking paper, just for the sake of being funny, or bright, or original.

In newspaper advertising, as well as in other forms, I believe that a graphic representation of the appliance you are pushing is the best method. If possible, show it in action, a demonstrator cooking a meal; a man taking a bath (handle with care, however); a fixture equipped with the lamps you recommend. We find that reproductions from photographs are the most successful.

The Milwaukee Gas Light Company works from picked prospect lists, figuring that it pays to expend enough money to have definite information at hand for the use of the solicitor and for advertising purposes and to employ a sufficient number of people to keep this record accurate and up to date. You are sure then that every letter, or circular, sent out is reaching the person you wish it to reach and is doing the maximum of good. Personal or circular letters have proven the best business getters in this case.

In sending letters it seems to be the best plan, if you have a process which will give you letters which can't be told from typewritten ones, to enclose letters to nearly every class under a two-cent stamp, increasing the chance of its being read at least a hundred per cent, as against using a one-cent stamp. The tone of

your letter must be suited to the prospect. There is a busy man who will not read a long argument, the person to whom you will have to explain the first thing about your proposition and who gets very few letters; the misinformed or prejudiced man or woman; the people who only need to be told about a new offer before they will close with you.

Enclose a return post card in every letter asking for a call by a representative. Such cards, when returned, rarely fail to be productive of closing a sale.

The sending of a letter should be followed within a week or ten days at the outside, by a call from a solicitor, whether there has been a response or not.

The letters should be as near personal solicitation as possible in form.

Have you ever thought how much the personality of the man whose thoughts and ways of thinking are read by the thousands of consumers, has to do with the attitude of the public toward your company? Frederick Coburn, writing in *Public Opinion* of the causes of the popularity of the Boston elevated, says: "corporations may or may not have souls, but they have personalities and very distinct personalities. The Boston Elevated Company, in its eight years of existence, has somehow impressed itself upon the inhabitants of eastern Massachusetts somewhat as an individual impresses himself by trying to be square in his dealings with everybody, to be energetic and business-like and withal to keep his sense of humor."

He explains how this personality is worked out in good service, courteous treatment by employés and by the attitude toward the press.

Too much care can not be expended in the written message which goes forth as the exponent of this policy. Let it be in comely dress, let it be urgent in its appeal, yet let it not lack dignity, for in losing dignity it loses force—above all, let it be earnest, straightforward, having the ring of truth and you'll get the public ear.

National Electric Light Association.

The Southeastern Passenger Association and the Western Passenger Association have authorized a rate of a fare and one-third on the certificate plan from points in their respective territories to Atlantic City, N. J., and return, for delegates and their friends attending the twenty-ninth convention of the National Electric Light Association, to be held at Atlantic City, N. J., June 5 to 8, inclusive. Mr. George F. Porter is master of transportation.

Single-Phase Equipment for the Central Illinois Construction Company.

There seems to be a general falling into line among the railroads of the Middle West in the matter of adopting single-phase equipment for the operation of the interurban systems in that region, for within a few weeks two more companies have adopted single-phase equipment for extensions to their lines. Mention has been made in these columns of the apparatus recently ordered for this purpose by the Milwaukee Light and Power Company, and the present article describes the equipment for the second of these two recent developments, that of the Central Illinois Construction Company. On account of the extended territory which this company eventually plans to cover, as well as the new construction now under way, the question of the proper system of distribution has called for a most careful investigation. As a result single-phase alternating current has been adopted for the additional eighty miles of track being constructed and its use is anticipated on future extensions. The portion of track to be so equipped consists of two forty-mile lines, one connecting Bloomington and Peoria, the other lying between Springfield and Lincoln.

The present equipment of the Central Illinois Construction Company is direct current, consisting of heavy suburban type cars equipped with four General Electric seventy-five-horse-power motors, and their local demand for power is considerable when accelerating or when operating on grades. The cars contemplated for the new extensions are still heavier, and it is evident that the question of secondary distribution is one of great importance when such large equipments are used over a system so extensive. There is now high-tension distribution from the Riverton station at 13,200 volts, but this line is being changed to 33,000 volts, and the latter station will be supplemented by a second power-house located in Peoria with a common 33,000-volt transmission line connecting the two stations.

After careful investigation into the merits of direct-current rotary converter and alternating direct motor systems, the Central Illinois Construction Company has adopted alternating-current single-phase motors on their new eighty-mile extensions. These comprise ten seventy-five-horse-power, alternating-current compensated motor-car equipments, made by the General Electric Company, of Schenectady, together with the necessary substations, overhead line material, generating station equipment, etc. Each car equipment consists of four seventy-five-horse-power motors with the Sprague-General Electric system of multiple unit control adapted for use on alternating-current circuits. The equipments are so arranged that they will permit voltage control by means of the car transformers when running on alternating current, and series parallel resistance control when running on direct current. In addition to the rotor and control apparatus, complete General Electric air compressors for both alternating and direct currents and straight air-brake equipments will be installed, as well as arc headlights adapted for use on the twenty-five-cycle alternating-current supply. The trolley will be of the pantograph type with rolling contact, raised and lowered by compressed air.

The equipment just outlined will take care of the passenger service, but for hauling freight the operating company will employ a single-phase locomotive equipped for service on the same roads as the regular motor cars. This locomotive will be of the eight-wheel type, equipped with four 125-horse-power compensated alternating-current motors. The total weight of the locomotive complete will be fifty tons with a draw-bar pull of 20,000 pounds. It will haul its train at a speed of twenty miles an hour with the current supply at 3,300 volts and twenty-five cycles. In common with the motor cars for passenger service, the locomotive will be equipped with the Sprague-General Electric multiple unit control for operation on both direct and alternating currents. It will also be supplied with complete air-brake equipment.

To furnish additional power for this new rolling stock, the present generating station at Riverton will be supplemented by a 2,000-kilowatt Curtis steam turbine furnishing current at twenty-five cycles, and the new power-house at Peoria will be equipped with two 2,000-kilowatt Curtis turbines. Additional machines will be installed as soon as other lines, now under consideration, are constructed. The generator and high-tension distribution system will be three-phase and will feed the present rotary converter substations and also the eighty-mile section of track operating with alternating current.

The alternating-current trolley will be 3,300 volts of the well-known catenary type, suspended from brackets in the interurban sections and cross-suspended through the small towns. Feeding the trolley there will be four alternating-current transformer substations. Each substation will contain two 200-kilowatt single-phase transformers, with complete controlling high-tension and low-tension switchboard apparatus. These substations will be placed approximately twenty miles apart and are so arranged that trouble in any substation will automatically cut out that station without affecting operation on the rest of the line.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The "Excello" Arc Lamp for Interior Lighting.

A new arc lamp, designed particularly for interior lighting, has been brought out by the Excello Arc Lamp Company, 24 East Twenty-first street, New York city. Flaming arcs of the usual type, while very efficient as light producers, give off undesirable vapors and smoke when in service, and for this reason they are not suitable in general for interior lighting. Another feature of these flaming lights is the golden-yellow color of the light emitted. While most pleasing for certain classes of illumination, this quality of light is undesirable in stores or other places where colors are to be judged. A white light for such purposes is essential. This is obtained in the new "Excello" lamp by means of specially prepared carbons, which not only give off no smoke, but produce a light very white and pleasing. The mechanism of the lamp is substantially the same as that of the "Excello" flaming arc lamp for exterior lighting, though, on account of the new kind of service for which the "Snowball," as the interior type is designated, is intended, the windings of the controlling electromagnets are different. There are two carbons, inclined to each other at about twenty degrees and placed in a vertical plane, so that the arc formed across the tips will be projected downward. These carbons are fed downward, as desired, so as to maintain substantially a constant length of arc, the motion being controlled by a pair of electromagnets placed above in the case. The tips of the carbons project through an "economizer," a shallow inverted porcelain cup. This economizer serves not only to diffuse light which would otherwise be thrown upward, but protects, to a certain degree, the tips of the carbons from an excess of oxygen, and thus increases their life. The striking mechanism, operated by one of the electromagnets, by acting through a small bell crank, shifts one of the carbons sideways, bringing it in contact with the other, and thus starting the arc.

The arc thus formed at the tips of the two carbons is blown downward slightly by the action of the current itself, and the arrangement of carbons and economizer throws nearly all of the light emitted down through the lower hemisphere. There is no shadow due to a support placed beneath the arcs. This arrangement gives an excellent distribution of light for interior purposes.

Another feature of this lamp is the new globe designed for it. This is an opal globe having an ellipsoidal shape, which is not only graceful, but is shallower than the spherical globe, thus reducing the length of the lamp somewhat and giving it a pleasing outline. The carbons used in the "Snowball" lamp, as stated above, are specially made for it. They are about sixteen inches long, burning ten hours, and twenty-three and one-half inches, burning seventeen and one-half hours.

NEW "EXCELLO" ARC LAMP.

The lamp may be rated as a 900-watt, as it takes ten amperes and about ninety volts at the lamp. A candle-power rating varies according to the distribution considered, for the mean lower hemispherical candle-power is said to be about 2,200, while the mean intensity throughout to the lower ninety-degree zone is given as about 3,000.

The case of the lamp is neat and arranged to give ready access for trimming and cleaning. The lamp is easily lighted by means of a pull switch.

The "Snowball" lamp was exhibited last week for the first time in New York by Mr. H. M. Hirschberg, president of the Excello Arc Lamp Company.

Shipment of Heavy Pieces of General Electric Machinery.

The development of electrical manufactures, leading as it has to the design of generating units of constantly increasing capacities, has brought up some difficult problems in the transportation of large and heavy pieces of machinery. The largest electrical manufacturers in the world are naturally the ones to encounter the most interesting experience resulting from this growth. A factory whose incoming freight for one year, including raw material for its manufacturing operations, its fuel and building materials, amounts to more than 350,000 tons and whose outgoing freight for the same period exceeds 130,000 tons must handle all kinds, sizes and shapes from the annual incoming 133 miles of freight cars and must exercise more than ordinary care and foresight in preparing machinery for shipment in the fifty-mile outgoing freight train.

It is interesting to note some of the special shipping arrangements that have been developed to handle the large single pieces of electrical machinery now manufactured by the General Electric Company, at Schenectady, N. Y.

It is advantageous to build an entire armature in one piece ready to be installed, thereby saving a large amount of work at the factory and avoiding the necessity of sending expert armature winders to the place of installation. The method of constructing the armature in one piece is adopted by the General Electric Company in the manufacture of the Curtis steam-turbine generator in all sizes, the largest of which at the present time is capable of generating 12,000 kilowatts, though normally rated at 8,000 kilowatts. The armature of one of these 8,000-kilowatt turbine generators is naturally a heavy piece to ship, notwithstanding the fact that the weight efficiency of the turbine-generator is high compared to that of an engine-driven generator of equal capacity on account of the comparatively high speed permitted by the turbine drive.

The armature of the first 5,000-kilowatt Curtis turbine generator (built for the Chicago Edison company's Fisk street station) weighed about 111,000 pounds without the top bracket. It was found that no railroad in the country had available a car of sufficient capacity to transport the armature, while even the heaviest Gen-

eral Electric Company's special freight car was rated about six tons too low for the purpose under the Master Car Builders' Rules.

The armature was, however, loaded on its car, and after careful examination by inspectors of the New York Central Railroad Company, the shipment was accepted for transportation by that road and was ordered forward "special," *i. e.*, with a special locomotive and picked crew, and with only a sufficient number of cars to ballast the train.

Fig. 1 shows the armature in place on its car ready for housing, and Fig. 4 illustrates the housed armature and its extreme height compared with the ordinary box car. Under these conditions the armature was moved from Schenectady to Chicago in safety. The armature shown on this car is the heaviest single piece of freight ever shipped by the General Electric Company.

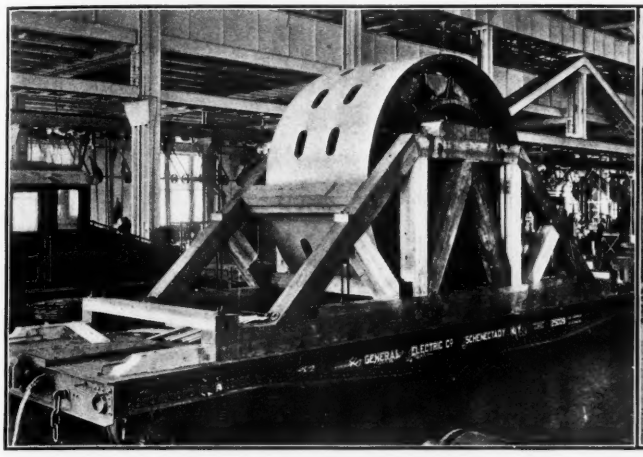


FIG. 1.—FIRST 5,000-KILOWATT CURTIS TURBO-GENERATOR ARMATURE, READY TO BE HOUSED FOR SHIPMENT TO THE CHICAGO EDISON COMPANY.

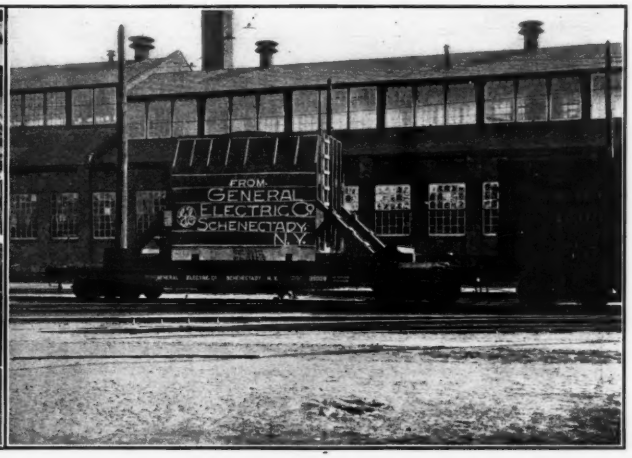


FIG. 4.—FIRST 5,000-KILOWATT CURTIS TURBO-GENERATOR ARMATURE, CASED FOR SHIPMENT. HEIGHT, COMPARED WITH ORDINARY BOX CAR.

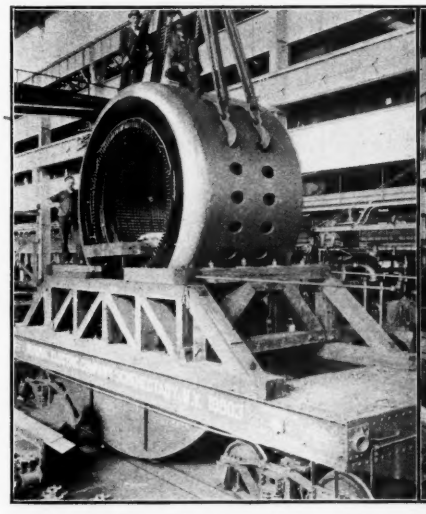


FIG. 2.—ADJUSTING STATIONARY ARMATURE OF 5,000-KILOWATT GENERATOR IN SPECIAL CAR.

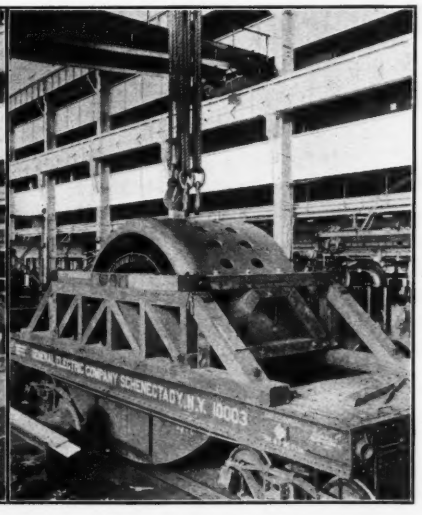


FIG. 3.—STATIONARY ARMATURE OF 5,000-KILOWATT GENERATOR, LOADED AND READY FOR CASING.

Orders received by the General Electric Company for four 5,000-kilowatt and two 8,000-kilowatt turbine generators for the New York Edison company's Waterside station, and eight 5,000-kilowatt turbine generators for the Port Morris and Yonkers stations of the New York Central Railroad again brought up the question of transportation. The armature of each of the 5,000-kilowatt machines consists of a single piece about twelve feet in diameter and eight feet wide, weighing about 122,000 pounds without the bearing bracket. It was found that by using the General Electric Company's new flat cars of special low type and 135,000 pounds capacity, the armature could be shipped as far as Port Morris—but only by a roundabout route, as the height of the bridges and the width of the roadbed between Schenectady and Yonkers would not admit of transporting the armatures direct by the Hudson River division of the New York Central. In order to forward the shipments from Port Morris on, it was proposed to lighter them from Port Morris to Yonkers and New York.

The inconvenience of this lighterage and its excessive cost on each piece led the General Electric Company to seek further means of transporting the armature over the direct all-rail route. Accordingly, a new flat car, specially designed to transport heavy machinery within the standard railroad clearances, was purchased at a cost about equal to the lighterage charge on the shipment of one armature only.

The accompanying illustrations, Figs. 2 and 3, show one of the 5,000-kilowatt armatures for the New York Edison company being loaded on this new car (GE-10003), and in its final position on the car ready to be housed for shipment, respectively. The car has a carrying capacity of 125,000 pounds, with privilege of ten per cent overload. It is thirty-two feet long and five feet six inches high above the rails, and has a rectangular well fifteen feet long and eight feet wide, which allows a shipment the size of an 8,000-kilowatt armature to be supported with its bottom about six inches above the top of the rails. The well is enclosed in sheet iron, to protect the load from dirt, and the load is slung on four heavy iron straps, which are secured in a timber truss bolted to the deck frame of the car.

The General Electric Company now has fifteen special freight cars of 1,630,000 pounds aggregate capacity, including three cars built with a well, as described above. It is worthy of note that the transportation department details a man to keep in constant touch with all of these cars by telegraphic communication with all of the roads over which shipments are made. Notwithstanding this special organization for expediting the return of "empties," the congestion of the railroads is so great that deliveries of several large machines have been delayed for lack of cars to ship them.

The Exide Sparking Battery.

The Electric Storage Battery Company, Philadelphia, Pa., manufacturer of the Exide battery, has produced in the 1906 model of the "Exide sparking battery" an apparatus which it is claimed will give satisfactory service with a minimum amount of attention. The plates are strongly burned to the connecting straps to ensure against broken joints. Special care has been taken in designing the terminals, which are cast in lead pillar straps extending through holes in the cover of the case, the holes being fitted with soft rubber gaskets to prevent the acid creeping

EXIDE SPARKING BATTERY.

up and corroding the terminals. The rubber jars are of the best quality to withstand breakage, and the sealing is tight and durable. These sparking batteries are supplied with either gelatinous or liquid electrolyte, as ordered. The cases are made of cherry wood finished in either natural wood or in black, treated with an acid-resisting composition. A sliding cover is used, which gives ready access to the cells.

The illustration herewith shows the completed battery ready for service.

Central Station Advertising.

The Curtis Advertising Company, 53-57 Farmer street, Detroit, Mich., has prepared a handsome portfolio containing samples of advertising literature suitable for a direct mailing campaign. The company is specially organized and equipped for the purpose of offering advertisers a very high class of service and a special method of cooperation in formulating and carrying out the plans for business promotion through direct-by-mail advertising methods. The company employs its own staff of originators, artists, writers and designers, and the printing of the advertising literature is carried out in a special department under the direction of experts in this line of business. The company designs, illustrates and creates a complete line of seasonable advertising and novelty specialties, including trade stirrers, reminders, follow-up advertisements, salesmen's advance cards, mailing cards, folders, blotters, memorandum books, envelope fillers, calendars and return folders.

The portfolio illustrates many forms of special advertising literature, the array being particularly complete and convincing of the ability of the Curtis company to carry out this character of service.

Wagner Electric Manufacturing Company Agency Changes.

The Wagner Electric Manufacturing Company, St. Louis, Mo., desires to announce that it has recently completed arrangements by which the sale of its apparatus in Texas, Indian Territory and Oklahoma will be taken care of by the Woods Electric Company, Houston, Tex., successor to D. F. Woods & Company. The sales department of this local branch of the Wagner factory will be under the immediate supervision and management of William F. Sullivan. Mr. Sullivan for a number of years has been intimately connected with the Crocker-Wheeler Company, and for the past two years has been attending to the interests of that company in its St. Louis office.

The Wagner company also announces that Mr. G. C. Henry, who formerly devoted a part of his time to its Atlanta (Ga.) territory, has so arranged his affairs that all of his time can now be given to the Wagner interests.

Rate Regulation.

State regulation of rates is on the increase, and gas and electric companies will serve their interests by guiding rather than by opposing the movement, says Mr. Alton D. Adams in the *Municipal Journal and Engineer*. Regulation of gas rates began in England with the passage of the Gasworks Clauses Act of 1847, and has continued with increasing force to date. Meanwhile electric rates have also come under Parliamentary attention. In Massachusetts, legislative control of gas rates was asserted in 1885 and of electric rates in 1887, and a movement is now under way to make this control more complete. California, in 1900, delegated to some of its municipal corporations, notably to the city and county of San Francisco, the power to fix rates for gas and electric service. During the present year the state of New York has followed the lead of Massachusetts by establishing a commission with power to fix the rates for gas and electric supply in all parts of the state, and the legislature of Illinois has delegated a like power to Chicago, to be exercised within the city limits. These examples are perhaps sufficient to indicate the present tendency.

It should not be assumed, however, that all this legislation has come about against the wishes of the gas and electric interests affected, for in some cases these interests have actually promoted bills for the reduction of their own powers of charge. An instance in point was the introduction of the sliding scale, as applied to gas rates, by the gas interests, in a bill before the British Parliament in 1875. Provisions for the sliding scale of gas rates and dividends have since become securely fixed in British legislation, and have proved to be very effective in the reduction of rates. The same Parliament that first applied the sliding scale to gas rates had before it one bill to promote competition by the erection of new gas works, and another to authorize government purchase of the gas plants in London. The defeat of both of these bills was probably due in no small part to the willingness of the gas interests to accept more stringent regulation of rates. So again, in the contest which led up to the creation of the Massachusetts commission, the gas and electric interests were willing to accept full government control of rates in order to avoid competition.

The fact evidently is that under a democratic form of government the gas and electric interests must choose between more or less constant competition on the one hand and a large degree of rate regulation on the other. A study of results under conditions of competition and rate regulation seems to indicate that the latter is much the more desirable for gas and electric interests. Certain it is that rate regulation does not necessarily carry with it the destruction of a high degree of prosperity in gas and electric supply. Great Britain furnishes much proof of this proposition, and more is not wanting on this side of the Atlantic, where the results under twenty years of rate regulation may be seen in the gas and electric plants of Massachusetts. It may be asserted with little fear of contradiction that no part of the Union can show a higher degree of prosperity in its gas and electric interests than exists in those of the Bay State. To ensure such results, however, it is necessary that the commission or other body to which the power of fixing rates is delegated shall be both fair-minded and able. It is at this point that gas and electric companies should endeavor to guide legislation affecting rates, rather than to waste their influence by opposing all rate regulation until some popular movement, led perhaps by persons whose motives are entirely selfish, vests authority to fix rates in local municipal officers, or those who have neither the technical nor legal training necessary for the work.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ROCKY MOUNTAIN BELL TELEPHONE COMPANY INCREASES CAPITAL STOCK—The stockholders of the Rocky Mountain Bell Telephone Company have voted to increase the capital stock from $2,500,000 to $10,000,000. The company operates under an exclusive license from the American Telephone and Telegraph Company. Its territory comprises the states of Idaho, Montana, Utah and Wyoming.

NEW CALIFORNIA LIGHT AND POWER COMPANY ORGANIZED—The California Gas and Electric Corporation, sometimes known as the De Sabla Company, has incorporated another subsidiary company called the Coast Counties Light and Power Company, with a capital stock placed at $1,500,000. The directors are Leo H. Sussman, Henry Malloch, L. W. Pryor, Walter J. McLean, William Bostwick, William B. Bosley and Raymond A. Morton. Mr. Sussman is one of the attorneys on the staff of the parent company. The De Sabla Company has already a Bay Counties Company and a Valley Counties Company. Besides these it has nearly forty other companies operating in twenty-three counties in the state.

ELECTRIC LINE FROM CANON CITY TO ROYAL GORGE, COL., ORGANIZED—The Canon City, Florence & Royal Gorge Interurban Railroad Company has been organized at Canon City, Col., with a capital stock of $1,500,000. A bond issue of $500,000 has been authorized, the bonds to run for twenty years, with guaranteed interest at five per cent, payable semi-annually. The following are the officers of the company: president, F. R. Street, New York city; vice-president and general manager, F. S. Granger; treasurer, Former-Governor James H. Peabody; secretary, Richard Houle; director, T. N. Harding. Orders have been placed for the building material and it is announced that the system will be in operation by July 1.

ERIE (PA.) LINES ACQUIRED—The Traction, Gas and Electric Finance Company, recently incorporated at Albany, N. Y., has acquired possession of the electric lines in Erie, Pa., and all of the electric lines and franchises covering the territory between Erie and Buffalo, N. Y., a distance of about 100 miles. The entire deal involves between $7,000,000 and $8,000,000. The lines taken over in this merger, aside from the city lines and allied interests in Erie, include the Erie & Northeast line, the Northeast & Westfield, the Brockton & Fredonia, the Fredonia & Dunkirk, the Buffalo, Dunkirk & Western, and the Hamburg Railway Company. Between Westfield and Brockton there is a gap of eight miles, over which a new trolley line will be constructed. In Fredonia the Fredonia Natural Gas and Light Company, the electric light and power plant and the steam-heating plant have been taken over. The Buffalo, Dunkirk & Western line is incomplete and will require about $600,000 to finish it. The line is about forty-two miles long.

EXTENSIVE PLANS FOR A NEW TUNNEL—It is announced that plans are under way for a comprehensive scheme of building two terminals and equipping the two Hudson river tunnels now known as the McAdoo tunnels. The Hudson & Manhattan Railway Company is to be formed with an authorized bond issue of $100,000,000, and a stock issue of $50,000,000. Besides equipping the two tunnels, the company will build two large terminals, one a $3,000,000, twenty-two-story building in Church street between Cortlandt and Fulton streets, New York city, and another at Herald square, New York city, between Thirty-second and Thirty-third streets. In addition, an electrically equipped road will be constructed between Jersey City and Newark on the Pennsylvania lines, besides a line connecting Jersey City and Hoboken, tapping the terminals of the Pennsylvania, Erie and Lackawanna railroads. The Hudson companies has been a construction company, and will turn over to the new company, the Hudson & Manhattan Railway Company, all of its property and contracts that have been made with the various railroads terminating in Jersey City and Hoboken. After its work of construction is completed the Hudson companies will go into liquidation. The Hudson companies has a capital of $21,000,000, but additional capital is now available for the new company. The financing of these projects calls for an expenditure during the next few years of about $60,000,000. The company will have in its treasury $50,000,000 of bonds reserved to complete further work. Harvey Fisk & Sons will be the syndicate heads, and it is through that banking house that the project will be financed.

NEW INCORPORATIONS.

LINCOLN, NEB.—The Steele City Telephone Company. Increased from $4,000 to $15,000.

LOVELL, ME.—Independent Telephone and Telegraph Company. $5,000. President, C. P. Hubbard; treasurer, O. E. Andrews, Lovell, Me.

RALEIGH, N. C.—Marion Light and Power Company. $25,000. Incorporators: J. L. Morgan, R. H. Bennett, of Marion; W. W. Lotspeich, Asheville.

AUSTIN, TEX.—San Antonio Traction Company, increased from $200,000 to $1,000,000; San Antonio Gas and Electric Company, of San Antonio, increased from $200,000 to $500,000.

GRAND RAPIDS, MICH.—Port Sheldon & Lake Shore Telephone Company. To construct and operate a telephone service in Olive township, Ottawa county, with offices in Grand Rapids. $2,000.

NOBLESVILLE, IND.—Noblesville Heat, Light and Power Company. $50,000. Directors: Thomas C. McReynolds, John O. Henderson, John M. Holliday, Alexander R. Holliday and F. T. Holliday.

ALBANY, N. Y.—Walton Home Telephone Company. To operate in Ulster, Sullivan, Delaware, Broome and Greene counties. $25,000. Directors: G. O. Mead, Roderick Fitch, J. S. Moore, J. H. Townsend, of Walton.

LINCOLN, NEB.—Peru Electric Light and Power Company. $4,000. Incorporators: E. Froher, A. N. Borst, G. K. Pettit, M. E. Good, O. M. Good, J. D. Graves, H. H. Whitfield, F. M. Pettit and J. D. Graves.

SPRINGFIELD, ILL.—Ohio & Mississippi Valley Telephone Company, of Carbondale. To do a telephone, lighting and power business. $100,000. Directors: J. B. Bundy, F. W. Willard and William H. Warder.

LITTLE ROCK, ARK.—The Imboden Power and Development Company. $100,000, of which $25,000 has been subscribed. Incorporators: C. B. Vaughan, M. H. Long, H. F. Sloan, O. C. Bacon and W. H. Vaughan.

SPRINGFIELD, ILL.—Peoria, Streator & Ottawa Railroad Company, of Champaign. To be constructed from Peoria through Tazewell, Marshall, Woodford and Livingston counties to Streator and Ottawa. $100,000.

ALBANY, N. Y.—Rochester, Scottsville & Caledonia Electric Railroad. To operate an electric road from Rochester to Caledonia. $500,000. Directors: H. C. Brewster, J. N. Beckley, Merton E. Lewis, Rochester.

SPRINGFIELD, ILL.—Rockford Railroad Company, Chicago. To operate a belt railroad in Rockford. $10,000. Incorporators and first board of directors: Blewett F. Lee, Sidney F. Andrews, C. E. Fereich, Andrew P. Humburg and W. E. Claflin, all of Chicago.

AUGUSTA, ME.—The St. Frances Telephone Company. To build and operate telephone lines in certain townships of Aroostook county, to connect with lines of the Fort Kent Telephone Company. $5,000. Officers: president, J. J. Wheelock; treasurer, Frank W. Mallett.

GUTHRIE, OKLA.—Lawton, Denton & Dallas Electric Railway Company, of Lawton, Okla., with a branch office at either Sanger, Denton or Dallas, Tex. To construct a road fifty miles in length. $250,000. Directors: E. S. McCully, Charles Henderson, J. T. Chambers and J. W. Lowery, of Sanger, Tex., and S. P. Iles and W. O. Allen, of Meers, Okla.

ELECTRIC RAILWAYS.

GLOUCESTER CITY, N. J.—Permission for the West Jersey & Seashore Railroad to lay electric line tracks through Gloucester City has been granted by the city council.

MONTREAL, QUEBEC—It is announced that the Terminal Railway, from Craig street to Bout de l'Ile, has passed into the hands of the Montreal Street Railway for something less than $500,000.

BATTLE CREEK, MICH.—It is stated that through cars will begin running over the electric lines from Battle Creek to Detroit and return May 1, and from Kalamazoo to Detroit and return by June 1.

BRISTOL, CT.—An important meeting of the Bristol & Plainville Tramway Company was held recently, at which time it was voted to extend the lines of the system during the coming spring and summer.

GREENBORO, N. C.—The county commissioners have granted a franchise for a trolley line from High Point to Greensboro, eighteen miles; work to begin in thirty days. E. J. Justice, of Greensboro, is trustee of the syndicate.

WORCESTER, MASS.—The Worcester & Northern Street Railway Company will begin the construction of the proposed line from Holden to Princeton, over Wachusett mountain, some time in March. This line will connect with the Gardner & Fitchburg trolley line.

MEMPHIS, TENN.—Before next winter's heavy traffic opens the power supply of the Memphis Street Railway Company will be increased two-thirds, according to a statement made by Thomas H. Tutwiler, manager of the company. In all about $200,000 will be spent immediately in improving the power service.

HUTCHINSON, KAN.—By a vote of more than three to one the city of Hutchinson voted aid to the amount of $20,000 for the building of an electric line through Hutchinson. In anticipation of the vote for the bonds carrying, much of the construction material was ordered, and the directors say it will be shipped at once.

SIOUX FALLS, S. D.—Announcement is made that construction work on the new electric line from Sioux Falls to Parker will be begun within sixty days. All of the right of way has been secured, with the exception of five miles, and this gap is expected to be closed without difficulty. The farmers along the line have contributed toward the purchase of the right of way through adjoining lands.

HOPKINSVILLE, KY.—At a meeting of the Hopkinsville city council the sale of the electric street railway, light, gas and power franchise to H. M. Dalton was ratified. Mr. Dalton has already posted a forfeit of $3,000 to guarantee that he will begin actual work on the street railway system within ninety days and have at least five miles in operation within twelve months.

BURLINGTON, IOWA—Articles of incorporation have been filed by the Fort Dodge, Des Moines & Southern Railway Company to operate a steam and electric line from the two cities mentioned through Boone. The headquarters are to be in Boone. The new company is formed of men interested in the Newton & Northwestern Railway Company, and will soon take over the Newton line.

RAVENNA, OHIO—The right of way is being obtained for an electric line to extend from Alliance to Canal Dover and New Philadelphia *via* Bayard, paralleling the Cleveland & Pittsburg Railroad. A branch is also projected through Bayard to Kensington and Hanoverton to Lisbon. The line will be a feeder to the Cleveland, Alliance & Ravenna line about to be constructed through Ravenna by J. W. Holcomb and other Cleveland promoters.

SPRINGFIELD, OHIO—The Springfield, Southwestern & Cincinnati traction line is a new road to be built the ensuing season. Work is to be started early in the spring. The road is to run from Springfield to Wilmington *via* Clifton, Cedarville, Jamestown and Port William. Eventually it is to be extended to Cincinnati. This statement is authorized by G. Harry Frey, who has been working on the project for the last six years. Contracts have been let.

AMES, IOWA—The Newton & Northwestern Railroad Company has concluded the purchase of the road, equipment and franchise rights of the Ames & College Railroad, extending east and west across the city of Ames and a distance of two miles out to the Iowa Agricultural College. It is stated that the road will be incorporated and made a part of the Newton company's new electric system, connecting Des Moines with Boone, Ames, Fort Dodge and intermediate points.

RACINE, WIS.—The Milwaukee Electric Railway and Light Company will in all probability extend its lines from Racine to Horlicksville, Franksville, Thompsonville, Raymond, North Cape, Eagle Lake, Brown's Lake and Burlington. Manager Beggs has assured the farmers in these towns that when the petitions they are circulating, asking for the extensions, are in he will order a survey of the route made. Already 500 have signed. The route will cover territory that at present has no railway facilities.

PUEBLO, COL.—Definite arrangements for two new electric lines in southern Colorado have been made and preliminary work is in progress. A line will be built by the Pueblo Traction Company, sixteen miles eastward, from Pueblo to Avondale *via* Vineland, following the course of the Bessemer canal. It will be a freight line for sugar beets. The other trolley line will connect Florence and Cañon City, nine miles, and the Fremont county fruit region. It is the intention also to build this road to the top of the north cliff of the Royal gorge, whose walls are 2,000 feet high, enclosing the cañon of the Arkansas river.

BEAUMONT, TEX.—At a meeting of the stockholders and incorporators of the Beaumont Terminal Railway Company the following officers were elected: R. C. Duff, president; George A. Clark, vice-president; R. C. Welles, general manager; Charles H. Stroeck, treasurer; R. P. Elstner, secretary and auditor. Directors were elected as follows: R. C. Duff, Charles H. Stroeck, George A. Clark, Mark Wiess, A. L. Davis, R. C. Welles and W. F. Keith. The purpose of the company is to build a belt line around the city in the interest of the Frisco system through the Colorado Southern, New Orleans & Pacific. It was decided to start work on the line as soon as the plans can be prepared.

WHEELING, W. VA.—Dillonvale, the flourishing mining town on the Wheeling & Lake Erie, in Jefferson county, Ohio, will be connected with Wheeling by trolley if the plans of a new company are carried out. The Wheeling Traction Company is believed to be concerned in the project. The new company is known as the Dillonvale & Ohio River Traction Company, and its purpose is to build and construct a street car line for the conveyance of passengers and freight. The capital stock of the company is $10,000, and the incorporators are James T. Hodgens, of Portland Station; Thomas J. Stringer, Lewis Lipphart, William P. Francis, of Martins Ferry, and William C. Fawcett, of Wheeling. The new company is incorporated to build a five-mile stretch of track from Dillonvale to Rayland.

OLYMPIA, WASH.—The formal certificate showing roughly the route of a proposed electric line in Spokane, Lincoln and Stevens counties, has been received by the secretary of state. It recites a resolution adopted by the Spokane & Big Bend Railway Company at a recent meeting at Spokane and is certified to by W. H. Plummer, the president, and by Secretary F. C. Robertson. The resolution recites the purpose of the company to build and operate an electric line from Spokane *via* Crescent, Reardan, Davenport, Lorraine, Egypt and Crystal City to the Fort Spokane military reservation near the mouth of the Spokane river, then across the Spokane river and the reserve and along the east bank of the Columbia river to Kettle Falls. The capital stock of the company has also been increased to $3,000,000.

RICHFIELD SPRINGS, N. Y.—The men behind the plan to build the Ilion, Morris and Sidney electric road estimate the cost of the line at $471,960, and the cost of the equipment at about $159,000. The cost of the road from Morris to Sidney is $321,230, making the total for the fifty-six miles, fully equipped, $963,690. It is proposed to form a company with a capital of from $600,000 to $1,000,000. The road will run from Ilion to Columbia Springs, three miles; Columbia Springs to Cedarville, five miles; Cedarville to Winfield, four miles; Winfield to Bartow's Corners, three miles; Bartow's Corners to West Exeter, four miles; West Exeter to Burlington Flats, four miles; Burlington Flats to Garrattsville, seven miles; Garrattsville to New Lisbon, four miles; New Lisbon to Morris, four miles; Morris to Gilbertsville, six miles; Gilbertsville to Sidney, twelve miles; total, fifty-six miles.

PERSONAL MENTION.

MR. ARTHUR F. STANLEY, the well-known electrical supply man, has associated himself with P. M. Fletcher Company, 32-34 Frankfort street, New York city.

MR. B. C. McCUNE has been appointed manager of the Johnstown (Pa.) office of the Bell Telephone Company. Mr. McCune succeeds Wesley R. Ellis, who has been acting manager for some time. Mr. McCune was formerly stationed at Charleroi.

MR. FRANK B. BURWELL, Uniontown, Pa., has been appointed district manager of the Bell Telephone Company, with headquarters at Charleroi. The district of which Mr. Burwell will have charge includes Belle Vernon, Charleroi, Brownsville, Monessen, Monongahela, California and Donora.

MR. P. C. BURNS, president of the American Electric Telephone Manufacturing Company, Chicago, Ill., is the subject of a sketch in the April issue of *Success*. Mr. Burns, as is well known, is one of the pioneers in independent telephony, and this recognition will be interesting to his many friends in the field.

MR. CHARLES R. COAR has resigned his position with the Northwestern Telephone Company to accept a position with the Twin City Telephone Company in its engineering department. Mr. Coar was recently appointed a member of the Minnesota State Board of Electrical Examiners by Governor Johnson.

MR. R. H. REED on March 31 will close his fourth year as manager of the Reeves Engine Company, Trenton, N. J. On this date he severs his connection with the company. Mr. Reed has been particularly successful in this connection, and will continue, it is understood, as a sales manager for high-speed engine interests.

MR. F. A. STRATTON, of Mount Vernon, N. Y., has retired from the presidency of the Westchester Lighting Company and has been elected chairman of the board of directors, succeeding H. E. Gawtry, formerly president of the Consolidated Gas Company, New York. Mr. Stratton has served as vice-president and president of the Westchester Lighting Company for seven years. During his term he merged nearly all of the lighting companies of Westchester county into one concern with a capital of $25,000,000. Mr. Stratton will still remain president of the Northern Westchester Lighting Company, of which he is the principal owner, and which is capitalized for $2,000,000.

NEW PUBLICATION.

A VITAL FACTOR IN BUSINESS MANAGEMENT—Under the title, "A Vital Factor in Business Management," Mr. W. F. Weiss, certified public accountant, 128 Broadway, New York city, has issued a brochure detailing the manifold services of the certified public accountant. This brochure is intelligently prepared and makes very pleasant reading. It is certainly a clean-cut analysis of the conditions which arise in business affairs, obviously necessitating the services of the expert. The following quotation from this brochure is interesting to every manufacturer: "Proprietors or managers of enterprises require concise information on the cost, expenses and results of operation and the financial condition of their business, and it is essential to have this information promptly available to enable them to act upon it where occasion may necessitate. Leaks or losses and their causes should be shown in their beginning in order that they may, if possible, be prevented or overcome."

LEGAL NOTE.

AN INTERESTING SUIT INVOLVING THE USE OF ASBESTOS AS AN INSULATING MATERIAL FOR MAGNET WIRES—In the Circuit Court of the United States for the Middle District of Pennsylvania, an interesting suit in equity between Louis W. Downes, complainant, and the Teter-Heany Developing Company, defendant, has been concluded. Under date of February 23, 1906, District Judge R. W. Archbald handed down an opinion deciding against the contentions of the complainant, and decreeing that the bill charging the defendant company with infringement be dismissed at the cost of the complainant.

ELECTRICAL SECURITIES.

The noticeable feature of last week's stock market was its continued dulness. This dulness, following the severe decline which has taken place in the last few weeks, is looked upon as a satisfactory condition of affairs. The attitude of speculators in general is deemed to be significant of the fact that no further decline is in sight, and that at present the situation is one of marking time, waiting for the disposal of adverse factors and some favorable impetus to start an upward swing in prices. The break in Consolidated Gas carried with it other industrials of a like nature, and the decision of the Supreme Court in the Chicago traction cases has so diluted these values that tractions in general have suffered. The severe weather which has prevailed all over the northern section of the country will very likely be reflected in decreased railroad earnings, but this, it is hoped, will be more than offset by the additional gains which will be possible in the agricultural sections due to the snow covering which is so necessary for a bountiful wheat crop. The iron and steel trade still continues to reflect a prosperous condition, with possibly a diminution in the orders ahead for finished steel products. The possibility of labor troubles in the anthracite coal fields still continues to be an adverse factor, but the known attitude of the labor leaders in seeking to avoid a strike, it is thought, will be provocative of an agreeable ending of the present series of conferences that is now on.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 17.

New York:	*Closing.*
Allis-Chalmers common	21
Allis-Chalmers preferred	57
Brooklyn Rapid Transit	84¼
Consolidated Gas	144
General Electric	168½
Interborough Rapid Transit	226½
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	59½
Mackay Companies (Postal Telegraph and Cables) preferred	73¾
Manhattan Elevated	155
Metropolitan Street Railway	112½
New York & New Jersey Telephone	154
Western Union	92¾
Westinghouse Manufacturing Company	185

The following statement exhibits the condition of the Western Union Telegraph Company at the close of the quarter ended December 31, 1905: Surplus October 1, 1905, $16,433,481.36; net revenues, quarter ended December 31, 1905, $1,853,196.75, a total of $18,286,678.11. Appropriating $1,217,022.50 for the January dividend and $331,300 for interest on bonded debt left a surplus December 31, 1905, of $16,738,355.61. The net revenues for the quarter ending March 31, based upon nearly completed returns for January, partial returns for February, and estimating the business for March, will be about $1,500,000. The board of directors of the Western Union company has declared a quarterly dividend of 1¼ per cent, payable on and after April 16. Books closed March 20 and will reopen April 2.

The regular quarterly dividend on Metropolitan Street Railway stock is payable April 16. Books close March 24 and reopen April 17.

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	244
Massachusetts Electric	69
New England Telephone	137½
Western Telephone and Telegraph preferred	91

The directors of the American Telephone and Telegraph Company have declared a regular quarterly dividend of $1.50 per share, payable April 16 to stock of record March 16.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	79⅛
Electric Storage Battery preferred	79⅛
Philadelphia Electric	7¾
Philadelphia Rapid Transit	29
United Gas Improvement	93¾

The Electric Storage Battery Company has declared the regular quarterly dividends of 1¼ per cent on both common and preferred stock, payable April 2 to stock of record March 27.

The directors of the United Gas Improvement Company have declared a quarterly dividend of 2 per cent ($1 per share), payable April 14 to stockholders of record at the close of business March 31.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	158
Metropolitan Elevated preferred	68
National Carbon common	92
National Carbon preferred	116
Union Traction common	6
Union Traction preferred	18

TELEPHONE AND TELEGRAPH.

ST. CHARLES, MO.—The Home Mutual Telephone Company has been organized at Portage.

FARGO, N. D.—A. L. Martin has organized a telephone company to build from Sentinel Butte to Yule.

DOLGEVILLE, N. Y.—The Interstate Telephone Company is making a number of improvements to its system.

COLUMBUS, OHIO—The Citizens' Mutual Telephone Company, of Delta, Fulton county, has been incorporated by William McQuillan, O. R. George, Frank Termelliger, Claude Sturtevant and C. D. Eberly.

TERRE HAUTE, IND.—The Citizens' Independent Telephone Company has been reorganized. A bond issue of $1,000,000 was ordered, the first $200,000 of which is to pay for the West Terre Haute plant and for extensive improvements.

SANDUSKY, OHIO—A Toledo syndicate, headed by J. S. Brailey, has obtained the controlling interest in the Sandusky Telephone Company, one of the leading independent companies of the state. The Toledo men are backed by the Busch St. Louis syndicate.

LOS ANGELES, CAL.—The Home Telephone Company has decided, by vote of the directors, to erect a new building on Olive street. The building committee has accepted the plans, and will order the immediate completion of the structure, to cost $175,000.

SYRACUSE, N. Y.—The new Bell Telephone building in Syracuse has been opened. The building is five stories high and has a frontage of sixty-six feet. It is 132 feet in depth, and is as nearly fireproof as possible. Architects are now working on plans for three additional stories.

KNOXVILLE, TENN.—The East Tennessee Telephone Company, in order to meet the increasing demand for service, has ordered an additional section for its present switchboard with a capacity of 300 telephones. This will make the total capacity of the exchange 3,000 instruments.

LOS ANGELES, CAL.—At the annual meeting of the Southwestern Home Telephone Company the following officers and directors were elected: president, K. C. Wells; vice-president, John F. Dostal; secretary, J. H. Breckenridge; treasurer, Bank of Redlands; directors, A. Gregory, C. H. Bigelow, R. J. Dunn and J. L. Shibley.

LANDER, WYO.—The Rocky Mountain Bell Telephone Company announces that as soon as snow leaves the ground the construction of a system of rural lines, centering in Lander, will be undertaken. These lines will run to Atlantic, Lewiston, South Pass and other settlements of the district, and as soon as the Shoshone reservation is thrown open for settlement will be extended through the reservation country.

DENVER, COL.—The former directors and officers of the Colorado Telephone Company have been reelected. President E. B. Field reports gross earnings for year ending December 31, 1905, $1,793,526; net earnings, $396,432. Value of real estate and plant, $6,141,121; number of subscribers, 45,745, a gain of 8,642. Mr. Field states that in order to meet the demands for additional telephone service the company has decided to offer this year at par to the stockholders $1,400,000 treasury stock.

FEDORA, S. D.—The Citizens' Economic Telephone Company, incorporated with a capital of $25,000 to construct lines in Miner and adjacent counties, expects to begin operations immediately, and before next fall will have poles up and wires strung all over the county. Farmers subscribed liberally for the stock, and the company is well financed. The officers of the new company are: president, T. C. Lewis; vice-president, J. E. O'Neal; secretary, T. E. Jones; treasurer, George Mishler.

YAMPA, COL.—The Colorado Telephone Company has set aside $85,000 for improvements in Routt and Grand counties during the present year. A new line is now being built from Kremmling to Steamboat Springs across the Rabbit Ear range, which will give the district much closer connections with Denver, as under the present system the line goes to Eagle and Leadville, and from there to Denver. The latter line, however, will be replaced by a new copper circuit, and over both lines separate wires will be strung for local and long-distance business.

WASHINGTON, D. C.—A plan has been agreed upon by Professor Willis L. Moore, chief of the weather bureau, and the officials of the Chesapeake & Potomac Telephone Company, by which the telephone subscribers on the lines of that company and the sublicensee companies throughout Maryland, Virginia and West Virginia are to be given the benefit of the daily weather forecast. This arrangement will extend to not less than 5,000 rural telephone subscribers in the three states named. They will be informed as to coming weather changes within a few minutes after the announcement of the official forecasts every day.

LITTLE ROCK, ARK.—The Telegraphone Company, of Arkansas, was organized at the session of the Arkansas Independent Telephone Association, and has been granted a charter. The capital stock is $300,000. The company will build 1,200 miles of wire throughout the state, to connect up the twenty or more independent companies. There will be main lines from Memphis to Fort Smith *via* Little Rock, Poplar Bluff, Mo., to Texarkana, with branch lines covering the greater part of the state. Twenty of the fifty independent companies of the state are affiliated with the movement. The officers are Eugene Hale, of Ozark, president; Dr. R. M. Drummond, of Russellville, vice-president; John B. King, of Texarkana, secretary; P. C. Ewing, of Little Rock, treasurer.

BUNCETON, MO.—A movement is on foot to merge all the independent telephone companies in Cooper county with a capital of $150,000. A meeting of stockholders in the several independent companies, as well as others interested, was held in Bunceton recently. Resolutions and recommendations were adopted providing for the incorporation of the Cooper County Telephone Company, with an authorized capital stock of $150,000, for the purpose of building independent trunk lines between the towns of Cooper county; also lines to every farm in the county. Colonel John S. Elliott, Charles A. Sombart, E. Cramer, N. A. George and Dr. J. T. Taylor were named as an executive committee. The new company expects to have 4,000 telephones, and will build 182 miles of trunk lines.

SALT LAKE CITY, UTAH—At a meeting of the directors of the Rocky Mountain Bell Telephone Company over $600,000 was appropriated for improvements to be made the coming year. The improvements are two stories to be added to the central building; and lengthening it seventy-seven feet, making it 170 by 50 feet, to cost $109,000; new switchboard, to be installed by July 1, 1907, at a cost of $237,250; $126,250 for new switchboards and telephones in twelve cities; new copper-wire circuits on poles already set, $47,968.60; installing lines in new fields, $98,720, making a total of $619,188.60 appropriated. Remodeling of the building will commence immediately. Between Provo and Price the company is to erect its poles, as the railroads state that theirs are carrying all the wire that they can.

SALT LAKE CITY, UTAH—An important transaction has been closed by the Rio Grande Western Railroad Company and the Utah Independent Telephone Company by the terms of which the telephone company secures all the telephones of the Rio Grande system and the Western Pacific now in course of construction. It also includes a private branch exchange, with a capacity of 160 stations, which will open up communication with all departments of the Rio Grande Western and the Western Pacific. By the terms of this contract the Independent Telephone Company has also procured exclusive privileges for the use of poles and right of way over the Western Pacific to San Francisco. This is of immense importance to Salt Lake, as it assures direct telephonic communication with the Pacific coast, a distance of some 800 miles. The deal is the result of a contract entered into between the Independent Telephone Company and the Western Union Telegraph Company last April by the terms of which the telephone company was granted exclusive use of Western Union poles in five states—Nevada, Idaho, Montana, Wyoming and California.

ELECTRIC LIGHTING.

CLINTON, N. J.—The electric light system is being enlarged.

HAILEY, IDA.—The plant of the Electric Light Company has been completed and placed in operation.

ENDICOTT, N. Y.—The village of Endicott has contracted with the General Electric Company for the installation of a lighting system.

POTTSVILLE, PA.—At a special meeting of the Tower City borough council H. T. Bressler, of that place, was given a contract to light the borough streets with electric lights.

POTTSVILLE, PA.—The Tremont borough council has signed a five-year contract with the Tremont & Pinegrove Electric Light Company to light the streets of the borough at a cost of $1,234 per annum.

HOLTON, KAN.—The Holton city council has decided to submit to the people a proposition to vote $80,000 for a waterworks system, two miles of sewer and an electric plant. The election will be held in April.

WHEELER, S. D.—S. A. Oliver has closed the deal which has been pending for some time whereby the Sturgis electric light plant passes from his possession. Allison Brothers & Bartlett, of Lead City, are the purchasers.

CORINTH, MISS.—The Alcorn Electric Light Company has organized under the new charter. Dr. P. T. Jones is the president; John H. Jones, vice-president and general manager, and W. Thomas Young, secretary and treasurer.

BABYLON, N. Y.—Babylon has signed a lighting contract with the Babylon Electric Light Company. The contract calls for the payment of $173.83 per month for 105 incandescent lights of twenty-five candle-power and two arc lights.

NEW WESTMINSTER, BRITISH COLUMBIA—The Burrard Power Company has made application for 2,500 inches of water from the Lillooet river and its tributaries. H. M. Burwell, of Vancouver, is one of the directors of the company.

MOUNT CARMEL, PA.—The Trevorton Electric Light and Power Company has elected the following officers for one year: Mary F. Crone, president; Henry J. Crone, vice-president; Isaac M. Jones, secretary, and O. H. Derk, treasurer.

LA GRANDE, ORE.—Walter M. Pierce has closed a deal whereby the Union electric light plant becomes the property of the Grande Ronde Electric Company. As soon as transformers can be procured Union will be connected with the Cove and La Grande power stations.

SALT LAKE CITY, UTAH—The United Electric Company has announced a reduction in the price of current from the present price of seventeen and one-half cents a kilowatt-hour. Hereafter the price will be for the first fifty kilowatt-hours, fifteen cents; for the second fifty, thirteen cents, and for the following fifties, twelve cents.

NEWARK, N. J.—The plant and real estate owned by the Essex Fells Electric Light and Water Company, at that place, has been mortgaged to the Fidelity Trust Company, of Philadelphia, for $150,000. The money is secured on first mortgage bonds, payable in sums of $1,000 each ten years from date, and bearing interest at four and one-half per cent.

MISSOULA, MONT.—Stevensville is planning for electric light and water systems. It is said that eastern capitalists have secured options on Henry Buck's property on the west side of the river, and have made the statement that their object in securing the land and water rights was for the purpose of generating power for electric lighting and also to furnish water for the town.

RICHMOND, IND.—By the report of E. B. Needham, city comptroller, for the year ending January 1, it is shown that Richmond has demonstrated that municipal lighting is a success. The actual profit from operating the plant, after deducting charges of every nature, including interest on bonds, was $12,187.57. The report also shows that Richmond people were paying a rate of fifteen cents a kilowatt-hour previous to the installation of the city's plant, while now the rate ranges from 4.8 cents to 7.2 cents per kilowatt-hour.

CLYDE, N. Y.—At a recent meeting of the Clyde board of trustees Thomas Robinson, of Clyde, attorney for the Wayne County Electric Company, appeared by request and renewed the contract for lighting the streets of the village for another five years from the first of next June. At present the village is paying for fifty street lights at $50 each per year, but the new contract provides for only forty-five lamps.

GUNNISON, COL.—The Gunnison city council has awarded the contract for building a new light and water plant, the city having voted bonds to the amount of $109,000 for the purpose. The bid of George H. Sethman, which was for $109,000 in bonds, was accepted. The new plant, which is to be one of the most complete in the state, is to be installed by January 1, 1907. John J. Huddart, of Denver, is to supervise the construction.

LAUREL, MD.—The Laurel Improvement Association held a large and enthusiastic meeting recently. The advisability of establishing an electric plant on the Patuxent river at Laurel was discussed, and it was decided to ask the mayor and city council to employ an expert to enquire into the matter. Messrs. Frank W. Awalt, Gustavus B. Timanus and Edward Phelps were appointed to act in conjunction with the mayor and city council.

MARION, IND.—The Marion city council has received a proposition from the Diesel Engine Company, of Indianapolis, whereby the Diesel Engine Company will place machinery in the Marion city lighting plant, furnish street lights for the city for ten years, on a basis of 300 lights at $55 a light a year, or 350 lights at $47.50 a year, the city to receive all income from commercial lighting; and, at the expiration of ten years, the plant, valued at $100,000, will become the property of the city.

MARQUETTE, MICH.—The Marquette County Gas, Light and Traction Company, operator of the traction system and the gas and electric lighting plants at Ishpeming and Negaunee, has gone into the hands of a receiver. E. B. Finch, secretary of the company and who has been in charge of its affairs, has been appointed receiver upon application of the trustee, the Merchants' Loan and Trust Company, of Chicago. The business will be conducted without interruption.

VALPARAISO, IND.—The board of public works in Michigan City has extended the franchise of the Michigan City Light and Power Company for a period of twenty-five years. The council must now pass an ordinance in accordance with the board's action before it becomes effective. The company is required to furnish commercial lighting at not more than ten cents per kilowatt-hour. The company agrees to furnish all-night arc lights for street service at $75 a year each for 150 lights or fewer; from 150 to 200, $74; from 200 to 250, $73; and over 250, $71.

MONTREAL, QUEBEC—Mr. H. S. Holt, president of the Montreal Light, Heat and Power Company, announces that the company's plant at Soulanges will be ready to deliver 14,000 horsepower at its Wellington street station by the first of August, 1907. As soon as the Soulanges plant is ready work will be started at the Buisson property, and the company's engineers state that if they begin work at Buisson at the completion of the Soulanges project in August, 1907, they will be ready with an additional 18,000 horsepower either by the fall of 1908 or the spring of 1909. Mr. Holt thinks that according to the present rate of expansion all this power will be required within three years' time.

UTICA, N. Y.—The Hudson River Electric Power Company has closed a contract with the Utica & Mohawk Valley Railway Company to supply the power for the electric service between Utica and Syracuse, and the power company's architects and electricians are at work preparing plans for the enlargement of the local plant to accommodate the machinery which will furnish the increased demand for power. The electric company will more than double the capacity of the present building on the flats and will install larger and more modern machinery. It will also build one or more substations between Utica and Syracuse for the transmission of power. As soon as the weather will permit work will be commenced on an addition to the present building, 160 by 50 feet.

INDUSTRIAL ITEMS.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has ready for distribution instruction book No. 5,003, detailing the installation and operation of Bullock direct-current motors and generators, types "N" and "B."

THE H. T. PAISTE COMPANY, Philadelphia, Pa., will be pleased to send bulletin No. 30, describing Paiste panelettes, 125 and 250-volt rosettes, attachment plugs and "Baby" knife switches and cutouts, to any one interested. In addition to the text each article is carefully illustrated.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has published a large circular entitled "Telephone Competition and Its Benefits to the Public." This circular sets forth many of the advantages of the automatic service and gives a list of forty-five cities in which the system has been adopted. This circular will be sent upon request.

THE ELMER P. MORRIS COMPANY, 51 Dey street, New York city, manufacturer and exporter of wrought iron and steel poles and brackets, electric railway and lighting supplies, will be pleased to send catalogue No. 12 upon application. This catalogue illustrates and describes a complete line of overhead line material used in the construction and operation of electric railways.

THE HART MANUFACTURING COMPANY, Hartford, Ct., has ready for distribution booklet No. 10, which is a digest of the types and salient features of "Diamond H" switches. The company will be pleased to send this booklet upon request. The complete catalogue of products manufactured by this company, giving details and full information, will also be furnished upon request.

THE NOVELTY ELECTRIC COMPANY, 50-54 North Fourth street, Philadelphia, Pa., manufacturer of telephones and specialties and dealer in electrical material, will be pleased to send full information concerning its product upon request. This company has a large salesroom equipped with a very complete line of material and has facilities for making prompt shipments of orders of any magnitude.

THE PHOENIX GLASS COMPANY, New York city, manufacturer of electrical glassware, is attracting widespread attention through its "Inner Globe Wisdom." The fact has just come to light that the poetry which the advertising department of this company has recently perpetrated upon the electrical industry has made such a hit that the company is besieged with requests for editions in leaflet form to supply the demand.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., has just completed the installation of an electrical equipment of a large manufacturing plant at St. Johns, P. Q., Canada. The plant consists of four 250-kilowatt, engine-type generators at 150 revolutions per minute, and one 100-kilowatt at 260 revolutions per minute. Also a 100-kilowatt motor-generator set, and about thirty motors varying in size from seventy-five horse-power to seven and one-half horse-power.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, Ill., has closed its Norfolk (Va.) office and will in the near future open an office at Richmond, Va. The office located at 602 Empire Building, Pittsburg, Pa., will be closed April 1 and moved to 10 and 12 Wood street. A store building has been secured for the purpose of making a general display of air compressors and tools. A large stock of apparatus will be carried as soon as the factories are in a position to furnish the material. An up-to-date repair department will also be maintained for the benefit of the company's many customers in the Pittsburg district. The office at Seattle, Wash., has been closed and a new office opened at 84 Sixth street, N., Portland, Ore. The company reports an entirely satisfactory business both at home and abroad, with all of the factories working double time.

THE SPRAGUE ELECTRIC COMPANY, New York city, is distributing a unique advertising card emphasizing the popularity of the Sprague Electric Company's round-type motor. The card shows allegorically a niche in the Hall of Fame, containing a round-type motor, the tablet beneath bearing this inscription: "The motor that made electric drive popular." This round-type motor was one of the most prominently successful among the earliest electric motors. The care uniformly exercised in the design and manufacture of these motors since they were first placed on the market has greatly extended their use and firmly established their popularity in the field of the application of electric power to mechanical drive.

TRADE-MARK DECISION—A decree has been entered in the case of the Babcock & Wilcox Company against the Aultman & Taylor Machinery Company for infringement of trade-mark in the United States Circuit Court for the Eastern Division of the Northern District of Ohio, in favor of the Babcock & Wilcox Company. The trade-mark of this company is sustained as good and valid. It consists of the word "steam" accompanied by a representation of the type of engine known as the "Aeolipile of Hero," which consists in part of a sphere. The defendant company is enjoined and restrained from making any use of this trade-mark or a device similar thereto.

THE I. P. MORRIS COMPANY, Philadelphia, Pa., in bulletin No. 2 publishes some very interesting data relating to the variation in power and efficiency due to changing heads with the revolutions constant, as illustrated in the preliminary design of a 13,500-horse-power turbine. This technical bulletin is published for the use of consulting hydraulic engineers and others who may desire information upon this subject. The curves on the plates shown are based upon the results of tests of wheels designed, built and installed by the I. P. Morris Company, and are applied to the preliminary design of a 13,500-horse-power wheel working under variable heads of from fifty feet to seventy feet, and running at a constant speed of 107 revolutions per minute.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has secured an order from the Pittsburg (Pa.) Railways Company for twenty emergency straight air-brake equipments for motor-cars, with CP-21 air-compressors, and ten emergency straight air-brake equipments for trail-cars. The cars upon which these equipments will be mounted are to be run singly and in two-car trains consisting of one motor-car and one trailer. This type of air-brake, sometimes called the semi-automatic, is essentially a straight air-brake system, having in addition an emergency valve on each car, which, in case the train breaks apart, disconnects the brake cylinder from the train line and connects it directly to the main reservoir, thus applying the brakes on all cars the same as in the automatic system. In ordinary service the operation is exactly the same as with a standard straight air-brake system.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

INDIANAPOLIS, IND.—The Thompson Electrical Company, of Evansville, has filed articles of incorporation with a capital of $5,000. The directors are John E. Butler, Theodore Rauschenbach and Henry Kollker, Jr.

TRENTON, N. J.—The Walker Foundry Company has been incorporated to manufacture electric motors, dynamos and other electrical machinery. The capital stock is $100,000 and the incorporators are Joseph Diehl Fackenthal, John J. Daly and Albert C. Wall, of Jersey City.

NILES, OHIO—The Niles Electrical Construction Company has been incorporated with a capitalization of $16,000. The incorporators are F. W. Stillwagon, W. Manning Kerr, W. H. Stevens, Edward Lyons and Harriet Lyons. The concern has been doing general electrical construction work in Niles for the last two years.

MINNEAPOLIS, MINN.—The B. F. H. Electrical Manufacturing Company, of Minneapolis, has filed articles of incorporation with the secretary of state. The capital stock is $1,000,000. The incorporators are Frank S. Bryant, A. W. Swanberg and C. M. Hofstad. The company will manufacture dynamos and other electrical machinery.

TRENTON, N. J.—Articles of incorporation of the Philippine Railway Construction Company, a $1,000,000 concern, have been filed. The company proposes to construct and equip lines of railway operated by steam or power of any kind in the Philippines and elsewhere. It will also construct telegraph and telephone lines. The incorporators are Albert C. Wall, Jersey City, and Edward B. Bruce and Jarvis P. Carter, New York city. The principal office in New Jersey is at 1 Exchange place, Jersey City.